8 July 1991

AD-A238 089

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE November 1989	3. REPORT TYPE AND DATES COVERED Test Results - May-Jul 89
4. TITLE AND SUBTITLE High Frequency AUTODIN Interface (HFAID) Test Report		5. FUNDING NUMBERS
6. AUTHOR(S) Gail Query, JITC, C3A-TCD AV879-5108		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Joint Interoperability Test Center Attn: C3A-TCA Ft. Huachuca, AZ 85613-7020		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Same		10. SPONSORING/MONITORING AGENCY REPORT NUMBER
11. SUPPLEMENTARY NOTES DTIC User Code 32213		
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for Public Release; Distribution is unlimited.		12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Data circuit throughput performance was collected for a DCS Mode 1 circuit interfaced and transmitted over an HF radio line using HF data modems and the Zenith/INTEQ High Frequency AUTODIN Interface Device (HFAID). The HFAID allowed a comparison the data throughput for various character packet sizes (5, 10, 20, 40, and 80 character) to be made. Test data was collected using an HF Channel simulator and over a 2000 mile HF radio link. Test done by the Joint Interoperability Test Center at Fort Huachuca, Arizona.

14. SUBJECT TERMS			15. NUMBER OF PAGES
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT

NSN 7540-01-280-5500

Standard Form 298, 890822 Draft
Prescribed by ANSI Std. 239-18

SF298

JOINT TACTICAL COMMAND, CONTROL AND COMMUNICATIONS AGENCY
JOINT INTEROPERABILITY TEST CENTER
FORT HUACHUCA, ARIZONA 85613-7020

IN REPLY
REFER TO:

C3A-TEE

NOV 24 1989

SUBJECT: High Frequency AUTODIN Interface Device (HFAID) Test Report

SEE DISTRIBUTION

1. Reference is made to the Joint Tactical Command, Control and Communications Agency (JTC3A) Five Year Interoperability Assurance Plan (FYIAP) Test 88-DCA-T001.

2. The enclosed final test report is provided for your information and retention.

3. POC is Mr. Gail Query, GS-13, C3A-TEE, AUTOVON 879-5110.

G.W. DURBIN
Department Head
Test and Evaluation Department

C3A-TEE NOV 24 1989

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DEFENSE COMMUNICATIONS AGENCY

JOINT TACTICAL COMMAND, CONTROL, AND COMMUNICATIONS AGENCY

RESTON, VIRGINIA

HF TO AUTODIN INTERFACE DEVICE (HFAID) TEST REPORT

88-DCA-T001
NOVEMBER 1989

HF TO AUTODIN

INTERFACE DEVICE (HFAID)

FINAL TEST REPORT
(FYIAP TEST 88-DCA-T001)

NOVEMBER 1989

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EXECUTIVE SUMMARY

The purpose of this report is to summarize the final test results of the testing accomplished under the Five Year Interoperability Assurance Plan (FYIAP) Test 88-DCA-T001. Sponsor of the test was the Defense Communications Agency (DCA), Defense Communications Engineering Center (DCEC) at Reston, Virginia. The objective of the test was to determine the feasibility of using a High Frequency AUTODIN Interface Device (HFAID) with high speed HF Modems and TSEC/KG-84C Communications Security (COMSEC) equipment, to provide a viable HF to AUTODIN Mode I data circuit at 1200 or 2400 bits per second (b/s). This device will be used for future Defense Communications System HF/AUTODIN Entry Stations worldwide.

Testing was commenced in August 1988 but was suspended in September 1988 when problems in the HFAID firmware were discovered. Test results for that period were documented in a Joint Interoperability Test Center (JITC) "Interim" Test Report dated December 1988. The HFAID was returned to the manufacturer for modifications. Testing resumed using the modified firmware during the period May-July 1989.

This test was conducted in accordance with a JITC test plan dated October 1988 in three phases: (1) Phase I, Back-to-Back testing (at Fort Detrick, Maryland), (2) Phase II, HF Channel Simulator testing (at Fort Detrick) and (3) Phase III, Over-the-Air testing (between Fort Detrick and Fort Huachuca, Arizona).

During Phase I and II testing at Fort Detrick, a minor HFAID "reframe" problem was discovered. With assistance from DCEC, the cause was isolated to a "block Ignore counter" threshold. Modification to the "ignore counter" was accomplished by the HFAID manufacturer and testing continued without further problems.

The test results show that the HFAID used in conjunction with the RF-3466 modem is capable of providing a viable HF to AUTODIN interface/circuit at data rates of 1200 and 2400 b/s. The HFAID also provides the necessary handshaking, data buffering and COMSEC control necessary to operate a Mode I circuit over HF radio links which experience long end-to-end delays due to the long interleaver delays introduced by new HF data modems. The HFAID is capable of maintaining the circuit and message integrity even with HF modem interleaver delays equal to 12.6 seconds and in a high error environment (greater than 10^{-3} bit error rate [BER]).

The HFAID is designed with the capability of dividing the Mode I 80-character block or packet into smaller packets for improved performance over HF radio circuits. Packet sizes of 80, 40, 20, 10, or 5 characters may be selected. Test results indicated that the optimum packet size is somewhere between 80 and 20. The optimum packet size depends on the quality of the HF radio link. A standard size of 40 is recommended as a nominal value to provide the best transmission efficiency over most links.

The HFAID, when coupled with the TSEC/KG-84C (COMSEC) and the RF-3466 Data Modem, will provide DCS HF Entry sites/users the capability to interface the AUTODIN system at 1200 or 2400 b/s. It will also provide an improvement in throughput (effective transmission speed) for most HF circuits, over the 300 b/s circuits used today.

Acknowledgements

The technical input and assistance from Mr. Bob Lueck, DCEC, Mr. Norman Rodgers, NSA and Mrs. Helen Smith, DCEC, contributed highly to the success of the HFAID test.

The outstanding support provided by the following Fort Detrick 1110th Signal Battalion and DCA personnel contributed greatly to the success of the test:

Mr. Paul Leadingham	1110th Signal Battalion
Mr. Stevenson	1110th Signal Battalion
Mr. Dick Weaver	1110th Signal Battalion (Contel)
SFC John I. Allen Jr.	1110th Signal Battalion
SPC Gregory N. Hurst	1110th Signal Battalion
SPC Darius Radvila	1110th Signal Battalion
SPC Timothy Green	1110th Signal Battalion
PFC Rafael A. Troncoso Jr.	1110th Signal Battalion
Mr Don King	DCA, Fort Detrick
Mr. White	DCA, Fort Detrick

SECTION 1

1. INTRODUCTION

a. Background

(1) During past United States Central Command (USCENTCOM) Joint Communications Support Element (JCSE) exercises, United States Air Force Rome Air Development Center (RADC) testing, and Joint Tactical Command, Control, and Communications Agency (JTC3A) Joint Interoperability Test Center (JITC) testing, various multi-tone and single tone data modems were used to transmit data at 75-2400 bits per second (b/s) over simulated and actual High Frequency (HF) radio channels. Results of these exercises and tests showed that the newer modems which employed data interleaving and forward error correction (FEC) encoding provided significant improvement in the error performance even for data rates at 1200 and 2400 b/s. However, to provide the improved error performance the new modems use data interleaver and deinterleaver techniques which can cause an end-to-end (data input-to-data output) delay of up to 12.6 seconds. This delay presents unique problems to HF radio link Communications Security (COMSEC) equipment and the Automatic Digital Network (AUTODIN) Mode I protocol that is normally used for HF-to-AUTODIN Entry circuits. In order to take advantage of the increased data rate and the improved error performance of the new modems while overcoming the problems that the increased delay presents to an AUTODIN Mode I circuit, the Defense Communication Agency (DCA), Defense Communication Engineering Center (DCEC) specified and procured an HF AUTODIN Interface Device (HFAID) in 1987.

(2) The HFAID is designed to provide an AUTODIN Mode I to/from unique HF Modem protocol conversion and interface. The unique HFAID protocol allows for the variance of the transmitted character block size in 80-, 40-, 20-, 10- and 5-character packets for increased data throughput over a burst error channel like that of an HF radio link. The HFAID also provides the necessary handshaking and data buffering to satisfy the requirements of the AUTODIN Mode I circuit when long data delays are induced by the HF modem interleaver/deinterleaver circuits. The HFAID is a modified version of the Tactical AUTODIN Satellite Compensation Interface (Mode I to Mode VI converter) Device (TASCID) which was built under another DCEC contract for use with satellite circuits which experience similar problems due to the satellite delays. The HFAID provides a Data Inhibit and "Crypto Resync" control lines to control the COMSEC equipment. To overcome the synchronization problems experienced with past COMSEC equipment (TSEC/KG-84 and TSEC/KG-84A) over HF circuits, the National Security Agency (NSA) developed an HF synchronization scheme into the TSEC/KG-84C. The new scheme allows the equipment to synchronize in less time, synchronize in a high error environment and to be tolerant of signal fades. Because of these improvements, the TSEC/KG-84C was used in conjunction with the HFAID for all testing.

(3) During July - September 1988, tests of the HFAID were conducted with the HF modems connected in a back-to-back configuration. Testing was accomplished at Fort Detrick, Maryland and Fort Huachuca, Arizona. The tests identified two discrepancies in the HFAID firmware. Testing was then suspended until the manufacturer could correct the deficiencies. Results of the preliminary tests are noted in a JITC interim test report dated December 1988 (see paragraph 3a[16]).

(4) Corrections to the HFAID firmware were made in March 1989 and further testing of the unit began in April and was completed in July 1989. This report covers the results of these tests.

b. Objective. The test objectives were : (a) to determine the feasibility of using the HFAIDs in conjunction with High Speed HF modems to provide a viable HF to AUTODIN Mode I data circuit for future HF/AUTODIN Entry Stations worldwide at 1200 and 2400 b/s, and (b) to document the equipment interconnections, switch settings and strapping options required for successful operation of the HFAID, KG-84C, HF modem, ASC and HF radio equipment string.

c. Scope

(1) Testing was accomplished in accordance with the JITC test plan, reference 3a(15), dated October 1988. Testing was conducted in three phases:

(a) Phase I, Back-to-Back testing at Fort Detrick, Maryland.

(b) Phase II, HF Channel Simulator testing at Fort Detrick.

(c) Phase III, Ionospheric (Over-the-Air) Link testing between Fort Detrick and Fort Huachuca, Arizona. The basic test configurations are shown in figures 1, 2 and 3.

(2) All phases were accomplished using HF modems: models RF-3466 (39 tone), MD-1061 (16 tone) and the HSM-1A (single tone). The major characteristics of each modem are provided in table C-1. The 5254B (single tone) modem was also planned to be used during the testing but was not available. Based on past HF modem comparison tests accomplished by JTC3A/JITC (reference 3a(17), USAF Rome Air Development Center and others, the Bit Error Rate (BER) performance of the 5254B was better than the RF-3466. Therefore, it is an engineering judgment that had the 5254B modems been used, the transmission efficiency would have improved over that of the RF-3466.

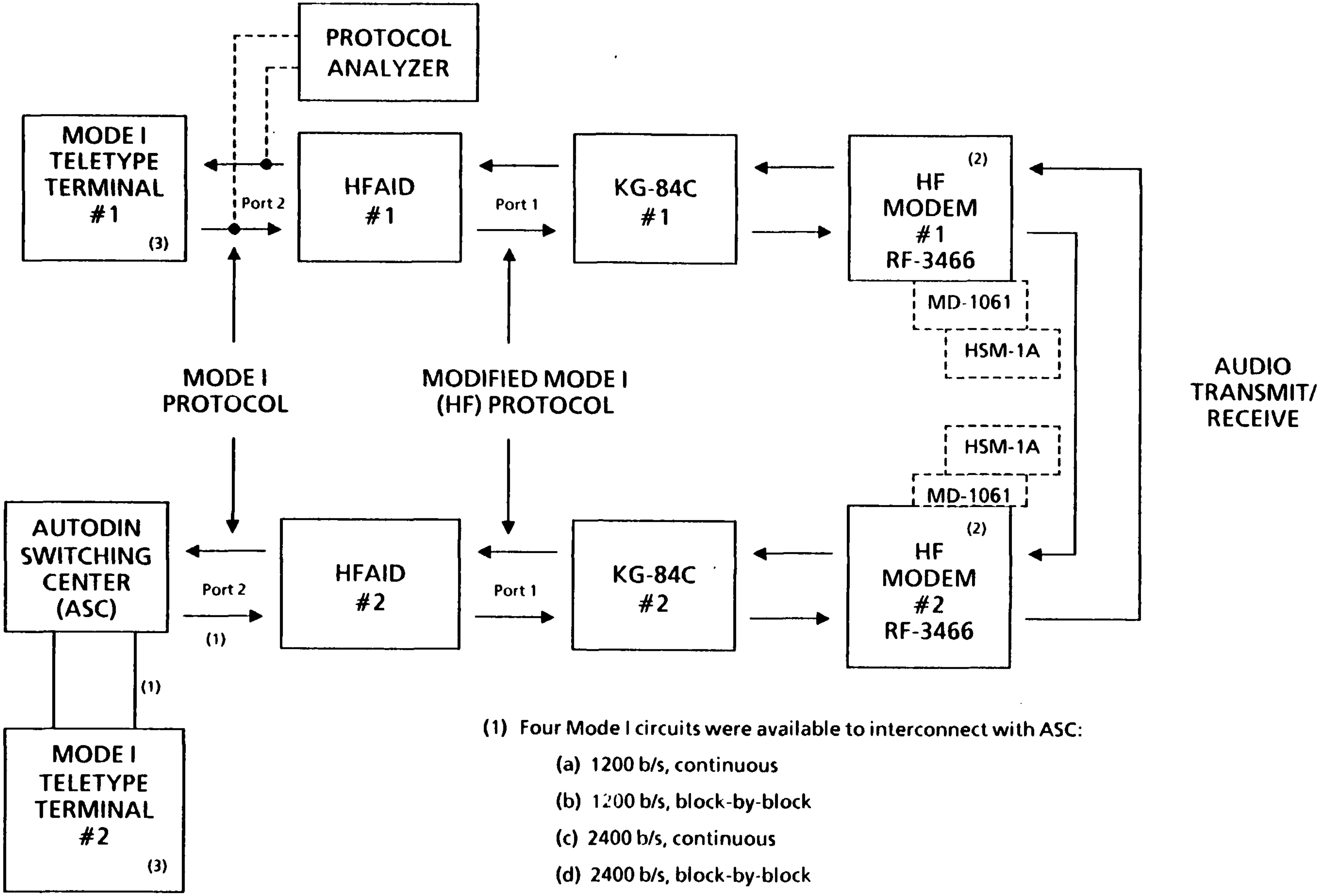
(3) During each test phase, message transmission time was measured and the corresponding transmission efficiency and the effect transmission rate (as compared to an AUTODIN Mode I circuit) was measured for various combinations of modems, modem interleaver/deinterleaver delays, data rates (1200 and 2400 b/s) and HFAID packet sizes.

2. DESCRIPTION OF THE TEST ITEMS

a. Interface Description. The major interfaces tested were those provided by the HFAID: the HFAID to AUTODIN Mode I interface and the HFAID to Modem interface. The interfaces are provided by an HFAID unique AUTODIN Mode I to HFAID protocol conversion. Related to these interfaces were the interconnection switch setting and equipment strapping options of each piece of equipment which allowed for the successful operation of the communication circuit.

b. Equipment Descriptions

(1) Model IA-5100(113). The Model IA-5100(113) HFAID is a microprocessor controlled protocol conversion unit which provides interfacing between an HF radio link and an AUTODIN switch. One side of the HFAID provides



(1) Four Mode I circuits were available to interconnect with ASC:

(a) 1200 b/s, continuous

(b) 1200 b/s, block-by-block

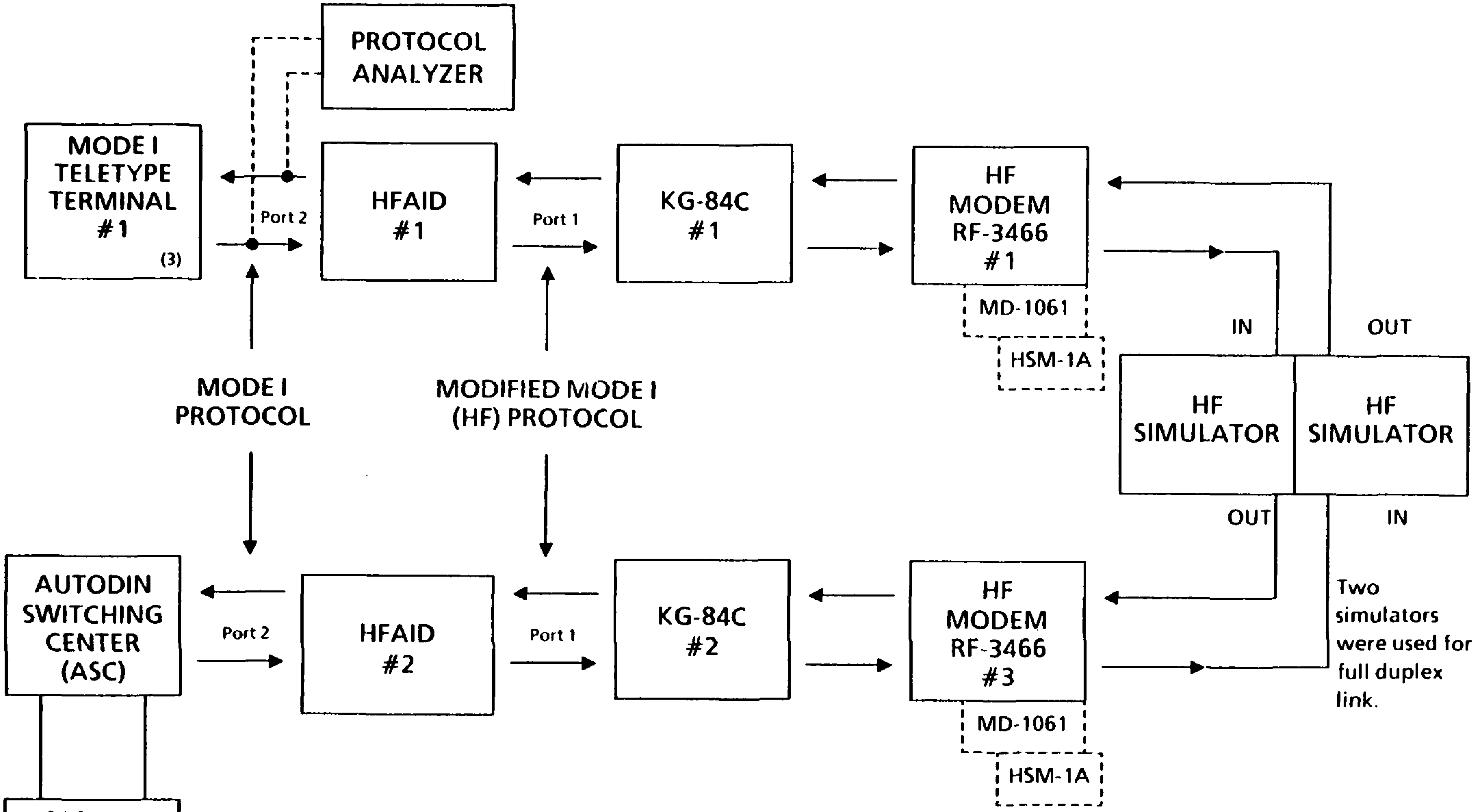
(c) 2400 b/s, continuous

(d) 2400 b/s, block-by-block

(2) Modems - Interleaver Delay Times: Short and Long (See Table C-1)

(3) Asynchronous Model 40 Teletype with Western Union Mode I Converter/Interface

Figure 1. Phase I, Fort Detrick Back to Back Test Configuration



(1) Four Mode I circuits were available to interconnect with ASC:

(a) 1200 b/s, continuous

(b) 1200 b/s, block-by block

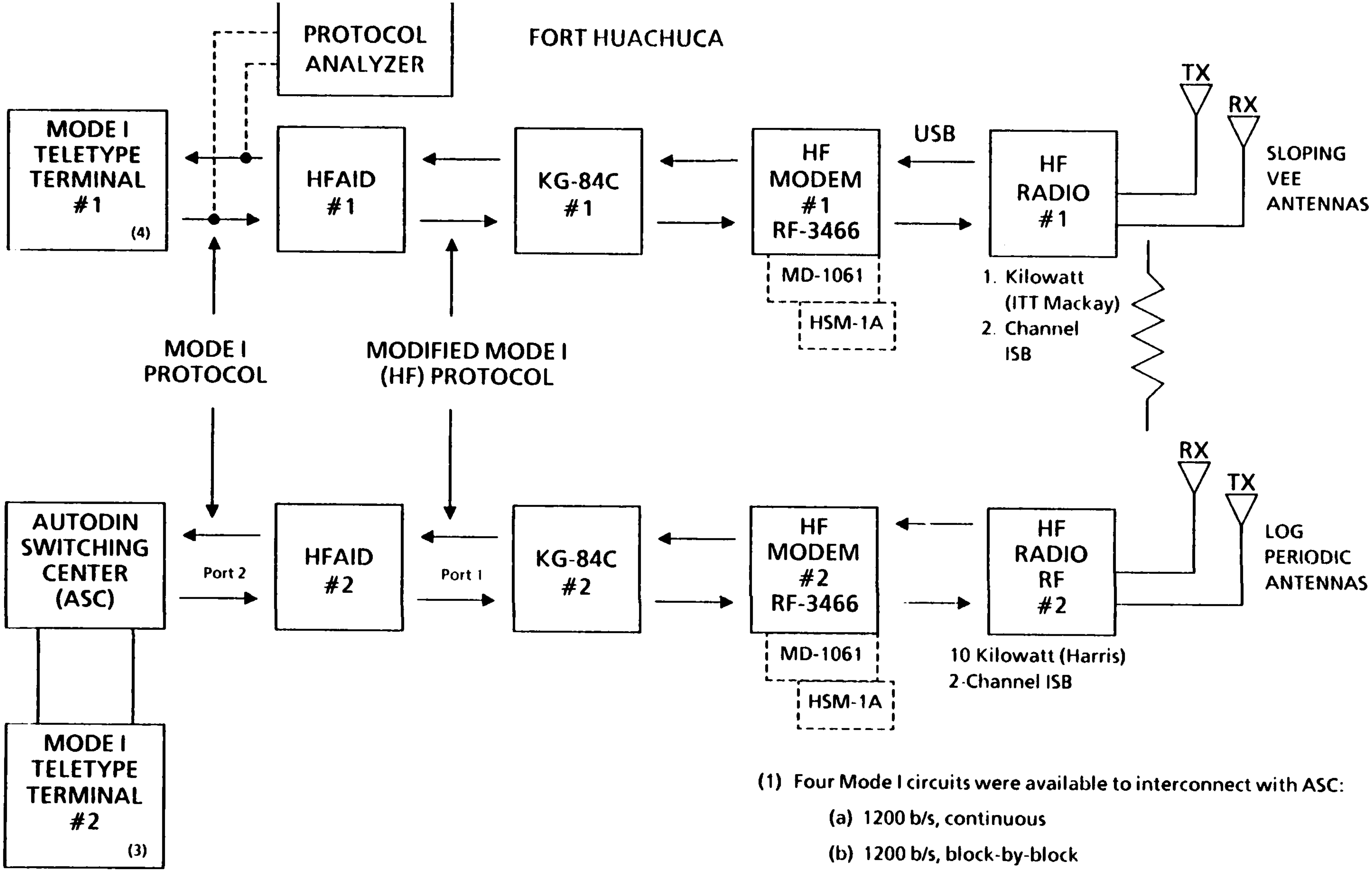
(c) 2400 b/s, continuous

(d) 2400 b/s, block-by block

(2) Modems - Interleaver Delay Times: Short and Long (See Table C-1)

(3) Asynchronous Model 40 Teletype with Western Union Mode I Converter/Interface

Figure 2. Phase II, Fort Detrick HF Channel Simulator Test Configuration



(1) Four Mode I circuits were available to interconnect with ASC:

- (a) 1200 b/s, continuous
- (b) 1200 b/s, block-by-block
- (c) 2400 b/s, continuous
- (d) 2400 b/s, block-by-block

(2) Modems - Interleaver Delay Times: Short and Long (See Table C-1)

(3) Asynchronous Model 40 Teletype with Western Union Mode I Converter/Interface

(4) Asynchronous Model 40 Teletype with INTEQ, Mode I converter/interface.

Figure 3 Phase III, Ionospheric (Over the Air) HF Radio Link Test Configuration

the normal Mode I circuit protocol for interfacing with a Mode I terminal or the AUTODIN switch, while the other side provides a special Mode I protocol for interfacing with HF modems and the HF radio circuit. The special HF protocol enables the selection of a variety of packet sizes ranging from the standard Mode I 80-character block to a block size of 5 characters.

Specific packet size selections are 80, 40, 20, 10 and 5. The HFAID also provides the necessary handshaking necessary for Mode I operation during long circuit delays caused by the various interleaver depth settings of the HF modems.

(2) **HSM-IA**. The HSM-IA is a high-performance modem capable of transmitting data at rates up to 3600 b/s in a standard 3 kHz single-sideband HF channel. The modem utilizes a single, adaptive equalized 8-phase modulated carrier with error coding and interleaving. The modem interleaver delay characteristic is fixed at 3.5 seconds for both the 1200 and 2400 data rates. Additional modem characteristics are provided in table C-1, appendix C.

(3) **TSEC/KG-84C**. The TSEC/KG-84C is a general-purpose telegraphy encryption unit designed for the encryption and decryption of TTY and data traffic over the data rate range of 50 to 64,000 b/s. The KG-84C is similar to the KG-84A but has additional capabilities. One of these additional capabilities is an enhanced synchronization scheme for use with HF radio circuits.

(4) **MD-1061**. The MD-1061(V) is a full-duplex modem designed for the transmission of digital data at rates of 75 to 2400 b/s over HF single sideband (SSB) radio circuits. The 16-tone quadraphase Differential Phase Shift Key (DPSK) MIL-STD-188 signaling format has been designed to provide efficient data transmission in the presence of severe multipath fading and impulse noise typical of HF ionospheric propagation. The MD-1061 provides for various in-band diversity, error coding, and time interleaving dependent on bit rate and modes selected. Additional modem characteristics for the 1200 and 2400 data rates are provided in table C-1, appendix C.

(5) **RF-3466**. The RF-3466 high-speed HF modem provides for the transmission of digital data at rates of 75 to 2400 b/s over an HF radio link. The RF-3466 employs Quaternary phase shift keying to modulate 39 tones, in-band Reed-Soloman error coding and various interleaving delays to provide enhanced performance over HF radio channels. Specific modem characteristics for the 1200 and 2400 data rates tested are provided in table C-1, appendix C.

(6) **Model 40 Teletype Mode I Terminal**. Two different configurations of the Model 40 Teletype and Mode I interface units were utilized at Fort Huachuca. The Model 40 Teletype Mode I Terminal consisted of a Model 40 Asynchronous Teletype Terminal and accompanying INTEQ/Model 3A-1, Asynchronous to Mode I interface device. At Fort Detrick, the Model 40 Teletype Mode I Terminal consisted of a Model 40 Asynchronous Teletype Terminal and accompanying Western Union Mode I to Asynchronous interface device. The Model 40 Asynchronous Teletype at Fort Huachuca was operated at 4800 b/s while the Western Union Mode I interface operated at the circuit data rate of 1200 or 2400 b/s. The Model 40 Teletype Mode I Terminal provides the capability to prepare, edit, transmit, and receive Mode I, JANAP 128 teletype messages.

(7) **AUTODIN Switching Center (ASC).** The ASC is a message switching center that stores, routes, and distributes messages that are introduced to the AUTODIN network.

(8) **High Frequency (HF) Radio Terminals.** During the "over-the-air" testing, different HF radio terminals were used at end of the radio links. At Fort Huachuca, a two-channel independent sideband (ISB) HF radio terminal consisting of ITT Mackay MSR 5050 ISB Receiver, MSR 6700 ISB Exciter and MSR 1020 1 Kilowatt Amplifier were used. At Fort Detrick, a four-channel ISB radio terminal consisting of Harris 10 Kilowatt transmitter (RF-745-02) and an RF-590A Receiver were used.

3. DOCUMENTATION/REFERENCES

a. Document List

(1) Five Year Interoperability Assurance Plan, Joint Tactical Control Communications Plan 3100, March 1988, 88-DCA-T001, HF to AUTODIN Interface Device (HFAID).

(2) Limited Maintenance Manual, TSEC/KG-84C, KAM-504A (RP) (C), October 1988.

(3) (U) Guidelines for the Use and Operation of the KG-84C (Draft) (FOUO).

(4) (U) Maintenance Manual for TSEC/KG-84C (C), March 1986.

(5) Memorandum for Director, Joint Tactical Command, Control and Communications Agency; Subject: Joint Interoperability Test Center of HF to AUTODIN Interface, 2 Jan 1987.

(6) Memorandum for Director, Defense Communication System Organization, Defense Communication Agency; Subject: Joint Interoperability Test Center of HF to AUTODIN Interface.

(7) Defense Communication Engineering Center (DCEC), Statement of Work for HF to AUTODIN Interface Testing, DCEC Acquisition Review Committee Package, 13 March 1987.

(8) HSM-1A Modem Manual, PLANTRONICS/Frederick Electronics Corporation, Frederick, Maryland.

(9) RF-3466 Modem Manual, Harris Corporation, RF Communications Group, Rochester, New York.

(10) Digital Data Modem, MD-1061(V)1/USC, Operation and Maintenance Instructions, MAGNAVOX Government and Industrial Electronics Company, General ATRONICS Corporation, Philadelphia, Pennsylvania.

(11) Modem IA-5100(113), Mode I/HFAID. Reference Manual (1989), Zenith/INTEQ Inc., Herndon, Virginia 22071.

(12) MIL-STD-188-116-1, Working Paper #12, dated 10 May 1988, Interoperability Standards for Information and Record Traffic Exchange Mode I.

(13) Test Report, Joint Tactical Command, Control and Communications Agency, Joint Interoperability Test Center, "HF Modem Comparison," May 1986.

(14) CCIR International Radio Consultive Committee, Recommendations and Reports of the CCIR, 1982, Volume III, Rec. 520-1.

(15) Joint Tactical Command, Control, and Communications Agency, Joint Interoperability Test Center, "HF to AUTODIN Interface Device (HFAID) Test Plan," dated October 1988.

(16) JTC3A, JITC, "High Frequency AUTODIN Interface Device (HFAID) Interim Test Report," December 1988.

(17) Test Report, "HF Modem Comparison", JTC3A, JITC, 21 May 1986.

b. Document Review. Information from the documents above was used to implement the interconnections between the equipments tested. Adequate information was available to successfully interface all equipment. However, the equipment operator or installer must be careful to use a continuous clock and turn the synchronization switch (switch S11) on the TSEC/KG-84C off to insure proper operation with the HFAID. Specific equipment interconnects and operational switch settings used for each test phase are provided in figures B-37 through B-48 (Phase I & II), B-108 through B-113 (Phase III) and tables B-1 through B-6 (Phase I & II), B-8 through B-12 (Phase III).

4. TEST ISSUE/CRITERIA

a. Test Issue. Does the HFAID provide an operable interface between the AUTODIN and High Speed Modems, and does the HFAID, TSEC/KG-84C (COMSEC) and HF Modem equipment string provide a viable HF to AUTODIN Entry circuit at data rates of 1200 and 2400? Related to these major issues were the following secondary issues:

(1) What was the HFAID circuit transmission efficiency as compared to the efficiency of a Mode I circuit?

(2) What was the HFAID circuit effective transmission speed or throughput?

(3) Was there a combination of HF Modem, HF modem interleaver delay, HF packet size and data rate that provided an optimum transmission efficiency and throughput?

b. **Criteria**. There was no pass or fail criteria for this test. The test was designed to gather engineering data for use in specifying and designing improvements for the Defense Communications System (DCS) HF/AUTODIN Entry Stations. The objective goal was to attain a message throughput or effective transmission rate which could exceed the 300 b/s data rate used by the DCS HF/AUTODIN Entry circuits today.

c. **Data Requirements and Collection**

(1) For each test phase (shown in figures 1, 2 and 3) and HF Modem, HF modem interleaver delay setting, HFAID packet size setting and AUTODIN Mode I operating mode setting shown in table 1 below, the transmission time to transmit short, medium or long messages from a Mode I data terminal, through the HFAID, TSEC/KG-84C, HF Modem equipment string, to the AUTODIN Switching Center (ASC), was measured. For each test combination, ten messages were sent and the average transmission time calculated. This average transmission time was used to calculate a transmission efficiency and an effective transmission speed (or effective throughput rate).

Table 1. Test Combinations

Test Phase	HF Modem	Bit Rate (b/s)	Mode I Protocol	SNR Ratio	Interleaver Delay (sec)	HFAID Packet Size (characters)	Message Size
I	RF-3466	1200	C	Max.	1.7,12.6	80,40,20,10,5	S,M,L
			B	Max.	1.7,12.6	80,20,5	S
		2400	C	Max.	1.5,9.8	80,40,20,10,5	S,M,L,
			B	Max.	1.6,9.8	80,20,5	S
	MD-1061	1200	C	Max.	1.6,6.4	80,40,20,1,5	S,M,L
			B	Max.	1.6,6.4	80,20,5	S
		2400	C	Max.	None	80,40,20,10,5	S,M,L
			B	Max.	None	80,20,5	S
	HSM-1A	1200	C	Max.	3.5	80,40,20,10,5	S,M,L
			B	Max.	3.5	80,20,5	
II	RF-3466	1200	C	25,20,15,13	1.7	80,40,20,10	M
		2400	C	30,25,20	1.6,9.8	80,40,20,10,5	M
	MD-1061	1200	C	35,30,25,20	1.6	80,40,20,10,5	M
		1200	C	35,30,25	6.4	80,40,20,10,5	M
		2400	C	35	None	80	M
	HSM-1A	1200	C	35,30,25	3.5	80,40,20,10,5	M
		2400	C	35	3.5	80	
III	RF-3466	1200	C	U	1.7,12.6	80,40,20,5	M
		2400	C	U	1.6,9.8	80,40,20,10,5	M
	MD-1061	1200	C	U	1.6,6.4	80	M
		2400	C	U	None	80	M
	HSM-1A	1200	C	U	3.5	80	M
		2400	C	U	3.5	80	M

C = Continuous

Max = Maximum Signal-to-Noise (SNR), no noise added

B = Block-by-Block

U = Unknown Signal-to-Noise
S = Short Message (approximately 15-line blocks)
M = Medium Message (approximately 30-line blocks)
L = Long Message (approximately 100-line blocks)

(a) The transmission efficiency was calculated using the following MIL-STD-188-116-1, Working Paper #12 (reference 3a(12)) equation:

E[%] = (t)100/tac
Where: E = Transmission efficiency in percent
t = Calculated theoretical time to transmit same character size/line block message using AUTODIN Mode I Protocol with no end-to-end delay
tac = Measured average time to transmit message using the HFAID with HF Modem interleaver/deinterleaver end-to-end delay

(b) The Effective Transmission Speed or Throughput Rate was calculated using the following equation:

Et (bits per second) = Total bits transmitted/average time to transmit the bits
Where: Total bits transmitted = the total characters transmitted per message X 8 bits per character

Average time to transmit the bits = the calculated average time to transmit the total bits per message from the Start of Header (SOH) to the final message Acknowledgement (ACK 2)

(2) During each test phase, all equipment interconnects, switch settings and strapping options were checked and proper circuit operation verified.

(3) The Phase I, Back-to-Back testing provided a baseline transmission time for each modem, modem interleaver, HFAID packet size, Mode I protocol mode, data rate and message size test combination.

(4) Phase II, HF Channel Simulator testing provided transmission times for each test combination while utilizing an HF channel simulator to simulate the fading, noise and multipath characteristics of an HF Channel. The channel condition simulated was that of a CCIR Recommendation 520-1 "poor" channel. The channel settings were as follows:

a Two equal level fading paths,

b Differential Time delay between paths of 2 msec,

c Frequency Spread (Fading Bandwidth) of 1 Hz and

d Zero doppler shift.

The CCIR Poor channel condition was chosen to provide an approximate worst case case test condition. The message transmission time was measured for various HF channel SNR settings. Harris Corporation HF channel simulators with a 3dB noise bandwidth of 5 KHz and a two-sided fading bandwidth were used.

(5) The Phase III, Over-the-Air testing provided data transmission over an actual HF radio link. The radio link used was between Fort Huachuca, Arizona, and Fort Detrick, Maryland, approximately 1900 miles. The transmission time to transmit a medium message from the Mode I terminal at Fort Huachuca to the ASC at Fort Detrick was measured. The transmission time was measured for each HF Modem, Modem interleaver delay, HFAID packet size and data rate combination.

5. TEST CONDUCT

a. All testing was conducted using the procedures set forth in the JITC test plan of reference 3a(15). All three phases of the test were accomplished using the HFAID with accompanying Mode I terminals, the Fort Detrick ASC, the KG-84C COMSEC equipment and three different HF modems. The three modems were the Harris RF-3466 (39 tone), Plantronics/Fredericks Electronics HSM-1A (single tone) and the Magnavox MD-1061 (16 tone).

b. At the start of Phase I, Back-to-Back testing, the HF modems and KG-84C COMSEC equipment were interconnected as shown in figure 4, and the Bit Error Rate (BER) measured for each modem. Specific interconnection information is provided in figures B-37 through B-42. Switch settings are provided in tables B-1 through B-5. The purpose of this test was to verify that the modems would provide error free operation prior to accomplishment of further testing. A BER test interval of 1×10^6 bits was used.

c. In addition, during Phase II testing, the BER performance of each modem at various HF channel simulator noise settings was measured. The test interval used for the BER measurements was 2×10^6 bits. The HF channel simulator settings remained as noted in paragraph 4c(4).

d. During both Back-to-Back (Phase I) and Simulator (Phase II) testing, the Mode I terminals, HFAIDs, TSEC/KG-84Cs, HF Modems and ASC were interconnected as shown in figure 1 and 2, respectively. The same equipment interconnections and switch settings were used for both test phases. Specific equipment interconnections and switch setting information are provided in figures B-43 through B-48 and tables B-2 through B-6. The ASC provided the timing for all equipments connected to the ASC side of the circuit and the HF Modem provided the timing for the equipment connected to the subscriber Mode I terminal side. This would be the normal timing configuration for most HF/AUTODIN Entry Stations.

e. During Phase III, Over-the-Air testing, the TSEC/KG-84 COMSEC and HF Modems at Fort Detrick were moved from their previous back-to-back (Phases I and II) test installation and installed in the COMSEC vault and the Primary Technical Control room, respectively. This move was made to match the installation and equipment interconnections typically found at most HF/AUTODIN Entry Stations. The transmit/receive data and timing lines remained the same as for the back-to-back and channel simulator tests, but the COMSEC and HF Modem control lines (clear-to-send, request-to-send, data-set-ready, data-terminal-ready) are tied high or

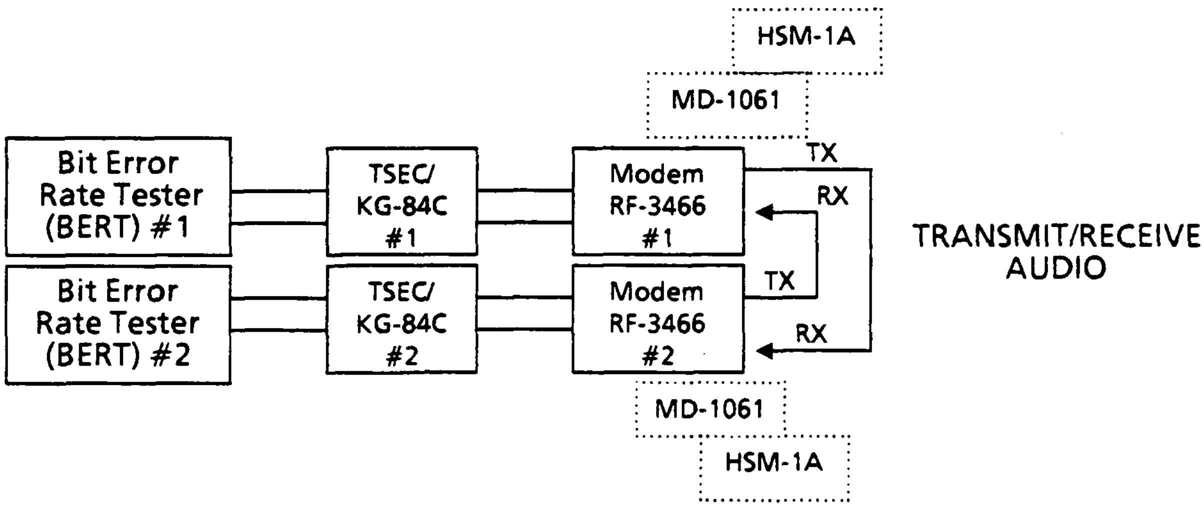


Figure 4. Data Sentry 10, TSEC/KG-84C, and HF Modem Test Configuration

to an enable state at all times. This is done at the COMSEC and HF Modem interfaces to reduce the number of interconnect lines required to go between each room at the ASC. The specific interconnects and equipment switch settings used are provided in figures B-108 through B-113 and tables B-8 through B-12.

f. For Phase III, Over-the-Air testing, an HF radio link was established between Fort Huachuca, Arizona, and Fort Detrick, Maryland. The Fort Huachuca site utilized an ITT Mackay, 1 kilowatt, 2-Independent Sideband (2-ISB) radio system and the Fort Detrick site utilized a Harris 10 kilowatt, 2-ISB radio system. On each radio system, the message traffic was transmitted on the Upper Sideband (USB) and the Lower Sideband (LSB) was used for an orderwire. The link was configured for full duplex operation. Frequencies used for the link were those frequencies chosen from 11 assigned frequencies. The frequency which provided the best propagation at any specific time was used. A number of the assigned frequencies were originally chosen based on an Ionospheric Communications Analysis and Predictions (IONCAP) prediction program. Prediction program outputs are shown in tables B-13 and B-14.

g. For each test phase the time to transmit a message from the subscriber (transmitting) Mode I terminal to the successful receipt of the message by the ASC was measured. The time to transmit the message was measured for the various HF modem, HF Modem interleaver delay settings, HFAID packet size, Mode I protocol mode (Continuous or Block-by-Block) and data rate settings (1200 and 2400 b/s). The various test combinations are shown in table 1. The transmission time was measured using the character trap function of a Digilog Protocol Analyzer and its associated timers. The timers were set to start when a Start Of Header (SOH) character from the transmitting Mode I terminal was detected and to stop when the Final Acknowledgement (ACK 2) was received from the ASC. For each test combination ten messages were transmitted and their transmission times recorded. The average transmission time was then calculated from the ten measurements.

6. TEST SUPPORT

a. Test Sites/Facilities

(1) All test phases were conducted utilizing the ASC at the 1110th Signal Battalion, East Coast Telecommunications Center (ECTC) at Fort Detrick, Maryland.

(2) Phase I, Back-to-Back and Phase II, HF Channel Simulator tests were conducted at Fort Detrick with the HFAID, TSEC/KG-84C, HF modem, and Mode I teletype terminals installed in a back-to-back configuration.

(3) Phase III, Over-the-Air tests were conducted using the HF radio facilities at Fort Huachuca, Arizona, and Fort Detrick, Maryland.

b. Personnel

TITLE	QUANTITY REQUIRED	RESPONSIBLE ORGANIZATION
Test Director	1	JTC3A/JITC
Associate Test Director	1	DCEC
Associate Test Director	1	USAISC/ECTC
Equipment Operators	6	JITC/ECTC
Data Collectors	4	JITC

c. Equipment

ITEM	QUANTITY	RESPONSIBLE ORGANIZATION
HFAID	2	DCEC
COMSEC KG-84C	2	JITC/NSA/NAVY
RF-3466 Modem	2	HARRIS CORP.
MD-1061	4	AIR FORCE
HSM-1A	2	PLANTRONICS CORP.
AUTODIN Switch	1	DCA/ECTC
Model 40 (Mode 1) Terminal	2	ECTC/JITC
DS 10 BERT	2	JITC
Protocol Analyzer	2	JITC

d. Special Test Circuits. The DCA representative at the Fort Detrick ASC made available four AUTODIN circuits. The circuits provided the following AUTODIN Mode I modes of operation:

FUNCTION	TYPE
Mode I Protocol	Block-by-Block and Continuous

Traffic	Routine, Unclassified, Genser, JANAP 128
Data Rate	1200 and 2400 b/s

e. **Funding**. Test support was funded by DCA/DCEC and the JTC3A/JITC. The HFAID was funded and procured by DCA/DCEC.

7. **TEST ORGANIZATIONS**. The overall test planning, coordination, direction, and reporting was provided by the JTC3A/JITC. The actual testing was accomplished by the combined assets and personnel from DCA, DCA/DCEC, 1110th Signal Battalion/ECTC, JTC3A/JITC, United States Air Force, Harris Corporation/RF Communications Group and the Plantronics/Frederick Electronics Corporation.

8. **TEST SCHEDULE**. Testing was conducted over the timeframe below:

a.	Phase I, Back-to-Back Baseline Testing:	15-31 May 89
b.	Phase II, HF Channel Simulator Testing:	1-16 Jun 89
c.	Phase III, Over-the-Air Testing:	26 Jun-14 Jul 89

9. **TEST RESULTS**

a. **Phase I, Back-to-Back Testing**

(1) Prior to the start of the Back-to-Back tests, the TSEC/KG-84C COMSEC equipment and HF Modems were interconnected as shown in figure 4 and the circuit errors measured over a test interval of 1,000,000 bits. Each modem combination was checked for error free operation at 1200 and 2400 b/s, at both short and long interval delays. One MD-1061 modem would not pass its "self check" and was replaced. All modems then provided error free operation in the loopback configuration.

(2) For the "back-to-back" testing, messages of short, medium and long length were used. Short was made up of approximately 15 line blocks with each line block containing 84 characters. Medium was made up of approximately 30 line blocks with each line block containing 84 characters. Long was made up of 100 line blocks with each line block containing 84 characters. However, the Fort Detrick asynchronous Model 40 teletype with its accompanying Western Union asynchronous to synchronous Mode I converter did not provide a true, continuous block by block transfer of the Mode I data to the HFAID. Because of the process delay in the converter, idle synchronization (SY SY) characters were inserted between the header and text blocks at 1200 b/s and between each block at 2400 b/s. Therefore, for the short, medium and long messages generated by the Model 40/Western Union Mode I converter/interface, the messages were recorded by a protocol analyzer and the messages printed. After printing the messages, the total number of characters sent to the HFAID, Mode I input port, were counted. This count included the Start of Header of Block #1 to the first Wait Before Transmit (WBT WBT) or Final Acknowledgement (FS FS [ACK 2 ACK 2]) was generated by the HFAID. The table below reflects the average number a characters transmitted for each message length. This character count is the total number of information characters that would have been exchanged between a Mode I terminal and the HFAID had there been a true Mode I exchange. Examples of the messages are provided in figures B-49 and B-50.

Data Rate (b/s)	Message Size	Total Planned Characters	Total Actual Characters	Mode I Transmission Time (sec)
1200	Short	1260	1685	11.2
	Medium	2520	2862	19.1
	Long	8400	8728	58.2
2400	Short	1260	2674	8.9
	Medium	2520	4418	14.7
	Long	8400	13140	43.8

(3) During the Back-to-Back testing, it was noted that the HFAID would declare an "out-of-frame" condition and send a resynchronization signal to the COMSEC at the end of the message transmissions. This occurred when the modem interleaver delays were greater than approximately two seconds. It was also noted during Phase II, Simulator testing, that the HFAID generated an unnecessary "reframe" when character errors were generated by the HF modems due to the noise, multipath and fading of the HF channel Simulator. During the simulator testing the "reframe" problem was found to be a function of the HFAID "ignore block" counter. Long modem interleaver delays and errored characters cause the retransmission of character blocks on the HFAID, HF Protocol port 1 side. Once the number of block retransmissions equals the "ignore counter" preset threshold, an "out-of-frame" condition is declared and a COMSEC resynchronization is initiated. DCEC requested the HFAID manufacturer (Zenith/INTEQ) modify the ignore counter to provide a greater number of retransmissions to occur before the HFAID declared a reframe. The manufacturer modified the ignore counter so the user could select the maximum number of blocks ignored by changing the switch settings of the HFAID "Dip Switch/Bank 2" switch #1 and 2. The following settings were programmed into the HFAID firmware:

Dip Switch Bank 3:

Switch S1	Switch S2	
0	0	Ignore 48* blocks before Resync. of the COMSEC (80-Character Block)
0	1	Ignore 96 blocks before Resync. of the COMSEC (80-Character Block)
1	0	Ignore 192 blocks before Resync. of the COMSEC (80-Character Block)
1	1	Ignore 384 blocks before Resync. of the COMSEC (80-Character Block)

* Note: The number of blocks ignored also increases as the HFAID packet size is decreased.

For all phases of testing, the "ignore counter" was set for the maximum number of blocks to be ignored (switch setting 1 1). More is said about the "ignore counter" setting in the discussion of the Over-the-Air test results.

(4) Because the "ignore counter" modification was accomplished after the back-to-back tests were completed, the message transmission times were redone for a couple of the RF-3466, long interleaver delay, 80-character packet size test

combination. This was done to verify that the modification had not changed the message transmission times. No change was expected since the earlier measurements were made by allowing the COMSEC to resynchronize between the transmission of each message. The two measurements were within ± 10 msec of the previous measurements; therefore, measurements for all test combinations were not reaccomplished.

(5) The transmission time, transmission efficiency and effective transmission speed results for the back-to-back testing are provided in figures B-1 through B-36.

(a) The transmission times shown in figures B-1 through B-18 are the calculated averages of the ten measurements made at each HFAID packet size. In almost all cases, the ten measurements made at each packet size were within a few milliseconds (+ /- 20 msec) of each other; therefore, a plot of all ten points is not provided.

(b) The transmission efficiency shown in figures B-19 through B-27 is calculated using the equation of paragraph 4c(1)(a). The time for the Mode I transmission (t) of the total characters transferred is shown in the table of paragraph 9a(2) above. The actual transmission time (tac) is the average transmission time for each HFAID packet size.

(c) The effective transmission speed shown in figures B-28 through B-36 was calculated using the equation of paragraph 4c(1)(b).

(6) In general, the results reflect the following findings:

(a) The HFAID successfully interfaced with the Mode I terminal TSEC/KG-84C (COMSEC), HF Modems and ASC. It provided the necessary interface/handshaking to satisfy the requirements of the Mode I interface between the HFAID and the Mode I/ASC terminal, and also to satisfy the HFAID interface with the COMSEC. The HFAID provided the necessary interface for successful message transmission over the test circuit even with long, end-to-end, HF modem interleaver/deinterleaver delays of up to 12.6 seconds. The operable switch settings are provided in tables B-2 through B-6 for Phase I & II and tables B-8 through B-12 for Phase III. It was noted that the TSEC/KG-84C must be operated with "continuous clock" and automatic synchronization detection "off" for proper HFAID operation. The "out of synchronization" or "out of frame" detection is provided by the HFAID.

(b) The message transmission time increases considerably with increased HF Modem Interleaver Delay. This is because the greater the interleaver delay, the greater the end-to-end (data input-to-data output) delay. The transmission time is also increased with the HFAID smaller packet sizes. This is because the HFAID HF protocol adds extra "overhead" bits to each packet in order to keep track of them. Specifically, it adds four extra framing characters for each packet. This adds a large number of "overhead" characters especially when the packet size is reduced to 10 or 5 characters.

(c) Correspondingly, the transmission efficiency and effective message transmission speed decreases with increased interleaver delay and reduced packet size. It is interesting to note that the transmission efficiency and transmission speed improves as the messages get longer. This indicates that the HFAID HF protocol becomes more efficient as the total number of 80-character packets to be

transmitted is increased. There is probably a message size above which the efficiency starts to decline as the HFAID input and output buffers become full. This is based on theory and was not substantiated by testing since the maximum message length used during the test was approximately 100 84-character line blocks. The 48 x 85 character buffer of the HFAID was able to process the 100-line block message with no noticeable delay.

(d) There was no significant difference in the transmission time when operating the Mode I terminal and ASC channel in continuous or block-by-block mode. This was because the HFAID input/output buffers are of ample size to accept up to 48 84-character Mode I line blocks without delay. Because of this fact, and the fact that most AUTODIN circuits are normally operated in a continuous mode, the majority of the Phase I, II and III testing was accomplished with the AUTODIN Mode I circuit in a "continuous" mode. This also reduced the amount of test combinations to be tested.

b. Phase II, HF Channel Simulator Testing

(1) The transmission time, transmission efficiency and effective transmission speed results are provided in figures B-51 through B-82, B-83 through B-89 and B-90 through B-96, respectively. The transmission time, transmission efficiency and effective transmission speed were measured or calculated the same as for the back-to-back Phase I tests. However, for the simulator tests, a simulated HF "poor" channel is introduced into the HF modem audio input/output path. The simulated channel induces errors into the Modem which would typically be introduced by the multipath, fading and noise of a ionospheric HF radio path. The multipath delay and fading bandwidth of the simulator were as noted in paragraph 4c(4). The noise level was varied to induce more and more errors into the path. The message transmission time was measured as a function of the Signal-to-Noise Ratio (SNR) and HFAID packet size. The BER performance of each modem was also measured and is provided in table B-7. A plot of the BER (vs) SNR data is provided in figure B-97. The HF channel simulator used was a Harris Corporation Simulator with a 5 KHz 3dB noise bandwidth and a fading bandwidth which reflects a double sided bandwidth. The results reflect the SNR for the 5 KHz channel. For comparing results to a nominal 3 KHz channel bandwidth or equivalent per HZ SNR, the following table should be used:

Signal-to-Noise Ratio (5 KHZ Channel)	Signal-to-Noise Ratio (3 KHz Channel)	Signal-to-Noise Density Ratio (Per Hz Bandwidth)
35	37	72
30	32	67
25	27	62
20	22	57
15	17	52
13	15	47

(2) The transmission times of figures B-51 through B-57 are the calculated averages of the time to transmit 10 messages for each HFAID packet size. All 10 measurements and the averages are provided in figures B-58 through B-82. These are provided to show the spread of the data points.

(3) The transmission efficiency and effective transmission speed is calculated as before using the calculated averages.

(4) As noted in the back-to-back test results, the HFAID "ignore counter" was modified during the simulator tests. As the channel SNR was increased the number of block retransmissions would increase, and once the "ignore counter" threshold was exceeded the HFAID would generate a "resync" command. The HFAID would also retransmit the message data blocks due to the delay caused by the HF modem interleavers and deinterleavers. With the "ignore counter" threshold set to the highest setting, the HFAID was able to operate successfully when using long HF modem interleaver delays and a degraded (channel BER of 1 x 10^3) channel.

(5) The results substantiate the following findings:

(a) As the SNR is decreased and the number of errored characters increase the number of block retransmissions increase, this increases the time required to transmit the message. Some of the increase can be overcome by going to a smaller packet size on the HFAID HF protocol. The optimum packet size seems to be around 40 or 20. When packet sizes are decreased to 10 or 5, the time required to transmit the additional overhead framing characters completely overshadows any improvement realized by the shorter packet size. It was also noted that the increased transmission time caused by increasing the HF modem interleaver delays completely cancels any retransmission improvement that ERROR improvement might have been gained through the use of the the longer interleaver delays.

(b) For SNRs of 20 or better, the transmission efficiency and transmission speed is better if a data rate of 2400 b/s is used. However, if the SNR decreases to 15 or below, the efficiency and effective transmission speed for 1200 b/s is better. In fact, at SNRs of 15 or below, it was observed that the error rate at 2400 b/s becomes so bad that the HFAID repeatedly declares an "out of frame " condition and sends a "resync. signal" to the COMSEC equipment. The message is finally delivered to the ASC but it takes an excessive amount of time (several minutes). It is important to note that the HFAID continues to maintain the integrity of the message even while COMSEC continues to resynchronize and even if the HF modem itself loss synchronization. As soon as the link or circuit recovers, the HFAID will continue to process the message.

(c) At a data rate of 2400 b/s, the MD-1061 and HSM-1A modems were unable to provide usable performance even at an SNR of 35 dB. This was expected for the MD-1061 which has no error coding or interleaving at the 2400 b/s rate. However, indications were that the HSM-1A would not tolerate the 2 msec multipath. When using either modem at the 2400 b/s data rate, the modem itself would not remain in synchronization.

(d) At a data rate of 1200 b/s and equal SNRs, the MD-1061 and HSM-1A modems provided degraded BER and message transmission time performance from that of the RF-3466 modem.

(e) At the request of NSA, the HFAID test circuit was operated using various TSEC/KG-84C synchronization options. The synchronization modes tried were (1) redundant (switch setting #1), (2) non-redundant (switch setting #2), (3) HF (switch setting #6) and (4) HF with Anti-Spoof (A/S) (switch setting #7). Messages were successfully sent over the circuit using the TSEC/KG-84C in either of the redundant or non-redundant modes. Operation using these synchronization

modes is mainly made possible since the HFAID resynchronization line controls all COMSEC resynchronization functions. The message transmission time was measured at selected SNRs and long interleaver delays using the COMSEC HF (A/S) TSEC/KG-84C synchronization mode. The results are provided in table 2. The results showed that the A/S mode does cause extension of circuit errors but this has no drastic impact on the overall message transmission time.

Table 2. Transmission Times for TSEC/KG-84C Operating in HF Mode 6 vs Mode 7

MODEM	BIT RATE (b/s)	INTER-LEAVER DELAY (SEC)	HFAID PACKET SIZE	SIGNAL TO NOISE RATIO	AVERAGE TRANSMISSION TIME TSEC/KG-84 SYNC MODE #6 (HF)	#7 (HF WITH A/S)
RF-3466	1200(C)*	12.6	80	25	45.6	45.5
				15	52.5	61.7
				13	92.9	91.5
	(1)2400(C)	9.8	80	30	42.9	44.4
				25	41.8	45.3

* C = Mode I continuous

(1) Measured BER for 2400(C)

Mode 6	- 1.14×10^{-4}	MEASURED AT THE RECEIVE OF EACH KG-84C FOR EACH HF MODEM
Mode 7	- 7.2×10^{-4}	
Mode 7	- 5.5×10^{-3}	
Mode 7	- 1.1×10^{-3}	

(6) Throughout the Phase II testing, it was noted that the HFAID was able to maintain the integrity of the transmitted Mode I message even during very poor channel conditions. The HF modem or TSEC/KG-84C COMSEC could lose frame and a number of resynchronization cycles could be initiated by the HFAID, and when the HF modems and COMSEC regained frame the HFAID message would complete the message transmission to the ASC. Depending on the channel condition and the HF modems capability to maintain synchronization or frame under those conditions, it would take several minutes (>10 minutes) to complete medium message transmission. However, the HFAID would maintain the message continuity.

c. Phase III, Over-the-Air Testing

(1) The average measured message transmission time, corresponding calculated transmission efficiency and effective transmission speed results for the over-the-air testing are provided in figures B-98 and B-104 through B-107. The scatter plots of the individual data points for the transmission times are provided in figures B-99 through B-103.

(2) As done during the back-to-back and HF Channel Simulator tests, a Model 40 teletype terminal with a Mode I interface was used at Fort Huachuca for generation and transmission of the Mode I message traffic. However, for the over-the-air tests, the Fort Huachuca Mode I interface and Model 40 Teletype Terminal were operated using a 4800 b/s clock generated from the HFAID. Interconnections are provided in figures B-108 through B-113 and switch settings B-8 through B-12. By operating the Mode I terminal at 4800 b/s, the time to transfer the message traffic to the HFAID was much faster than that required for the Mode I terminals at Fort Detrick (see table in paragraph 9a(2)). An example of the message transmitted between the Mode I terminal and the HFAID at Fort Huachuca is provided at figure B-114. The total characters exchanged per each medium message and the equivalent Mode I transmission time is shown below.

Data Rate (b/s)	Message Size	Total Planned Characters	Total Actual Characters	Mode I Transmission Time (sec)
1200	Medium	2520	3178	21.2
2400	Medium	2520	3178	10.6

Only messages of medium length (approximately 30 84-character line blocks) were used for the over-the-air tests due to available/usable circuit time. It is predicted that the transmission efficiency would improve as the message size increases as noted during the "back-to-back" testing.

(3) Over the entire two week test period, satisfactory messages transmission between Fort Detrick and Fort Huachuca was attained only on two days. At all other times the background noise level at Fort Detrick's receive was too high to allow the HF modems at Fort Detrick to stay in synchronization for any usable length of time. On a number of days, the noise might have possibly been overcome if the transmit power at Fort Huachuca could have been increased to 3 kilowatts or more. During approximately 80% of the time when the noise level was high at Fort Detrick, transmission to Fort Huachuca was possible due to the low noise floor and because Fort Detrick was able to increase their output power. The maximum transmit power used at Fort Detrick was 8.5 kilowatts (Peak-Envelope-Power)(PEP) and the minimum power used was 3.0 kilowatts (PEP). The maximum transmit power at Fort Huachuca was limited to 1 kilowatt (PEP). During the two days which the noise level at Fort Detrick dropped, message traffic was successfully exchanged at 1200 and 2400 b/s using the RF-3466 modems. No successful message exchange was possible using the MD-1061 or HSM-1A modems. During one of the poor days, the data rate on the RF-3466 was changed to 600, 300 and even 75 b/s. The link would not support message exchange even at 75 b/s data rate. The HF Modem at Fort Detrick would repeatedly go in and out of data synchronization.

(4) The IONCAP link propagation predictions are provided at tables B-13 and B-14. The optimum propagating frequencies followed those predicted in most cases. The cause for the high noise at Fort Detrick was not determined but the noise did increase as thunder storm activity moved into either location. However, a direct correlation between the increase in noise level and thunder storm activity could not be made. It is possible that noise could have been generated by a noise source within the Fort Detrick area.

(5) The Fort Detrick end utilized Rotatable Log Periodic Antennas for both transmit and receive. The site at Fort Huachuca used terminated Sloping Vee

Antennas. The Transmit antenna was 500 feet on each leg. The receive antenna was 250 feet on each leg.

(6) At both Fort Huachuca and Fort Detrick the HF Modem Request-to-Send (RTS), Clear-to-Send (CTS), Data Set Ready (DSR) and Data Terminal Ready (DTR) control lines between the TSEC/KG-84C COMSEC equipment and the HF Modem were tied high at all times. The only control line used by the COMSEC was the Receive Signal Detect (Rec Sig Det) line. During the link testing, it was noticed that during times of a deep fade or when the link was interrupted, the HF modem would lose data synchronization. When the link returned, the modem would try to resynchronize without sending a "preamble" for doppler (frequency) and phasing (multipath) correction. In most cases the RF-3466 modem was capable of regaining synchronization after a few seconds, but in a few instances the modems had to be powered down and then up again in order to cycle the modem RTS line. This caused the modem to send a new preamble. If the modem RTS line is tied high at all times, a new preamble will not be sent.

(7) As noted in figure B-104, the transmission efficiency using long interleaver delays (>2 seconds) at 1200 and 2400 b/s is lower then that when the HF modems employ the short interleaver delays ($\leqq$ 2 seconds). The error improvement obtained using the long interleavers is overshadowed by the decrease in efficiency due to the long end-to-end delays. Also, in most cases when the link could support 1200 b/s transmission, it could also support 2400. The transmission at 2400 would experience a larger number of block retransmissions but the overall transmission efficiency and effective transmission rate was better.

(8) In general, the HFAID packet size of 40 or 80 provided the optimum transmission efficiency.

(9) Again, as during Phase II testing, the HFAID was able to maintain the integrity of the message, even during very poor link conditions.

10. CONCLUSIONS

a. The HFAID does provide a viable interface between HF modems and the AUTODIN system.

b. The transmission efficiency of the HFAID circuit is lower than that of a normal Mode I circuit with aero end-to-end delay. This is expected due to the additional end-to-end delay provided by the HF modem interleavers/deinterleavers. As noted during the "back-to-back" testing, the HFAID circuit transmission efficiency approaches 100% that of the Mode I circuit as the HF modem interleaver delay setting is decreased.

c. The HFAID and RF-3466 combination provides an effective transmission speed that exceeds the current 300 b/s for present HF/AUTODIN entry circuits. For radio links which provide a channel BER of 10^{-3} or better, the HFAID/RF-3466 combination is capable of providing an effective transmission speed of 1200 b/s or greater, using a data rate of 2400 b/s and a short interleaver delay of 1.6 seconds.

d. Any increase in transmission efficiency due to the improved error performance of the HF modems using the link interleaver delays is completely overshadowed by the corresponding decrease in transmission efficiency due to the

increased end-to-end delay. HF modem interleaver delays of much over 2 seconds should be avoided.

e. The HFAID and RF-3466 combination provides an effective transmission speed that exceeds the current 300 b/s for present HF/AUTODIN Entry circuits. For radio links which provide a channel BER of 10^{-3} or better, the HFAID/RF-3466 modem combination is capable of providing an effective transmission speed of 1200 b/s or greater, using a data rate of 2400 b/s and a short interleaver delay of 1.6 seconds.

f. For degraded channel conditions, the HFAID was able to provide greater transmission efficiency by selecting smaller data packet sizes. However, for packet sizes of 10 and 5 characters, the transmission efficiency degrades because of the increased number of protocol "overhead" characters that are transmitted. For channel simulator tests, the optimum HFAID packet size was generally between 20 and 40 characters. For the over-the-air tests, the optimum packet size was generally between 40 and 80 characters. For the back-to-back tests using an error free channel, the optimum packet size was 80.

g. The "ignore counter" setting should not be set to its highest setting (1,1). This allows 384 line blocks to be ignored before a "resync" is generated by the HFAID. This can lead to a situation where the COMSEC is out of sync but it will not receive a resync from the HFAID until the "ignore counter" threshold has been reached. This could be several minutes (greater then 15 minutes) depending on the HFAID packet size, bit rate and "ignore counter" threshold setting selected. The smaller the HF modem interleaver delay the smaller the "ignore counter" threshold that has to be used.

h. The data rate should be set for 2400 b/s and other radio link parameters (i.e., transmitter power, antenna gain, space diversity or frequency diversity) changed to allow for a BER of 1×10^{-3} or better (approximately an SNR of 20 dB).

i. The MD-1061 and HSM-1A modems should not be used for data transmission at 1200 or 2400 b/s over HF radio links which are marginal due to multipath or noise degradation. For wireline or LOS applications, the modems may provide satisfactory performance.

j. For proper operation between the HFAID and the TSEC/KG-84C, the KG-84C must be set for continuous clock and synchronization (switch S11) "off".

11. RECOMMENDATIONS

a. Recommend that short interleaver delays (less than two seconds) be used. This will maximize the circuit throughput.

b. The RTS line between HF modem and COMSEC should be installed at HF/AUTODIN Entry sites to allow for the retransmission of the HF modem preamble after a deep fade or circuit interruption.

c. The MD-1061 and HSM-1A modems should not be used for HF radio skywave links operating at 1200 or 2400 b/s.

d. Recommend that if a standard HFAID packet size is to be used by the HF Entry sites, that a packet size of 40 be chosen. This provides a medium value which

should provide a nominal transmission efficiency for good and poor channel conditions. In conjunction with this 40 character packet size, the "ignore counter" should be set to generate a resynchronization after ignoring 96 blocks. This will mean that the HFAID will not ignore blocks for more than approximately 69 seconds before generating a resynchronization command. This should also provide a workable system for channels with a BER of 1×10^{-3} or better.

e. Further testing should be done with the HFAID at 2400 and 1200 b/s using an HF Radio link with space and/or frequency diversity. With space and/or frequency diversity and 10 kilowatt transmit power, a link with 80% to 90% availability may be possible as compared to the 10% or 20% achieved during this test.

f. When HFAIDs are procured and fielded for HF/AUTODIN Entry sites, recommend that the switch settings and interconnect information as noted in this report be added to JCS Publication 6.05. Also, the unique switch settings for the TSEC/KG-84C should be added to the KG-84C Joint/Combined Interface Procedure (JCIP) that is presently being prepared by this agency. The JCIP will cover the basic differences between the KG-84, 84A and 84C. In addition, it will cover a number of service or program (MILSTAR, Regency Net, etc.) unique applications.

APPENDIX A

GLOSSARY

ARQ	Automatic Request Repeat
ASC	AUTODIN Switching Center
AS	Anti-Spoof
AUTODIN	Automatic Digital Network
BER	Bit Error Rate
BERT	Bit Error Rate Tester
b/s	Bits Per Second
CHAR	Character/s
COMSEC	Communications Security
CTS	Clear-to-Send
DCA	Defense Communications Agency
DCEC	Defense Communications Engineering Center
DPSK	Differential Phase Shift Key
DSR	Data Set Ready
DTR	Data Terminal Ready
ECTC	East Coast Telecommunication Center
EOM	(End-of-Message)
JCSE	Joint Communications Support Element
JITC	Joint Interoperability Test Center
JTC3A	Joint Tactical Command, Control and Communications Agency
JTE	Joint Test Element (Now JITC)
HF	High Frequency
HFAID	High Frequency AUTODIN Interface Device
Hz	Hertz
KHz	Kilohertz
LBLK	Line Block
msec	millisecond
PEP	Peak Envelope Power
RTS	Request-to-Send
RX	Receive
sec	Seconds
SNR	Signal-to-Noise Ratio
SOH	(Start-of-Header)

TASCID	Tactical AUTODIN Satellite Compensation Device
TTY	Teletypewriter
TX	Transmit
USAISC	United States Army Information Systems Command

APPENDIX B

TEST RESULTS

APPENDIX B

TEST RESULTS

Section I - Phase I, Back-to-Back Testing

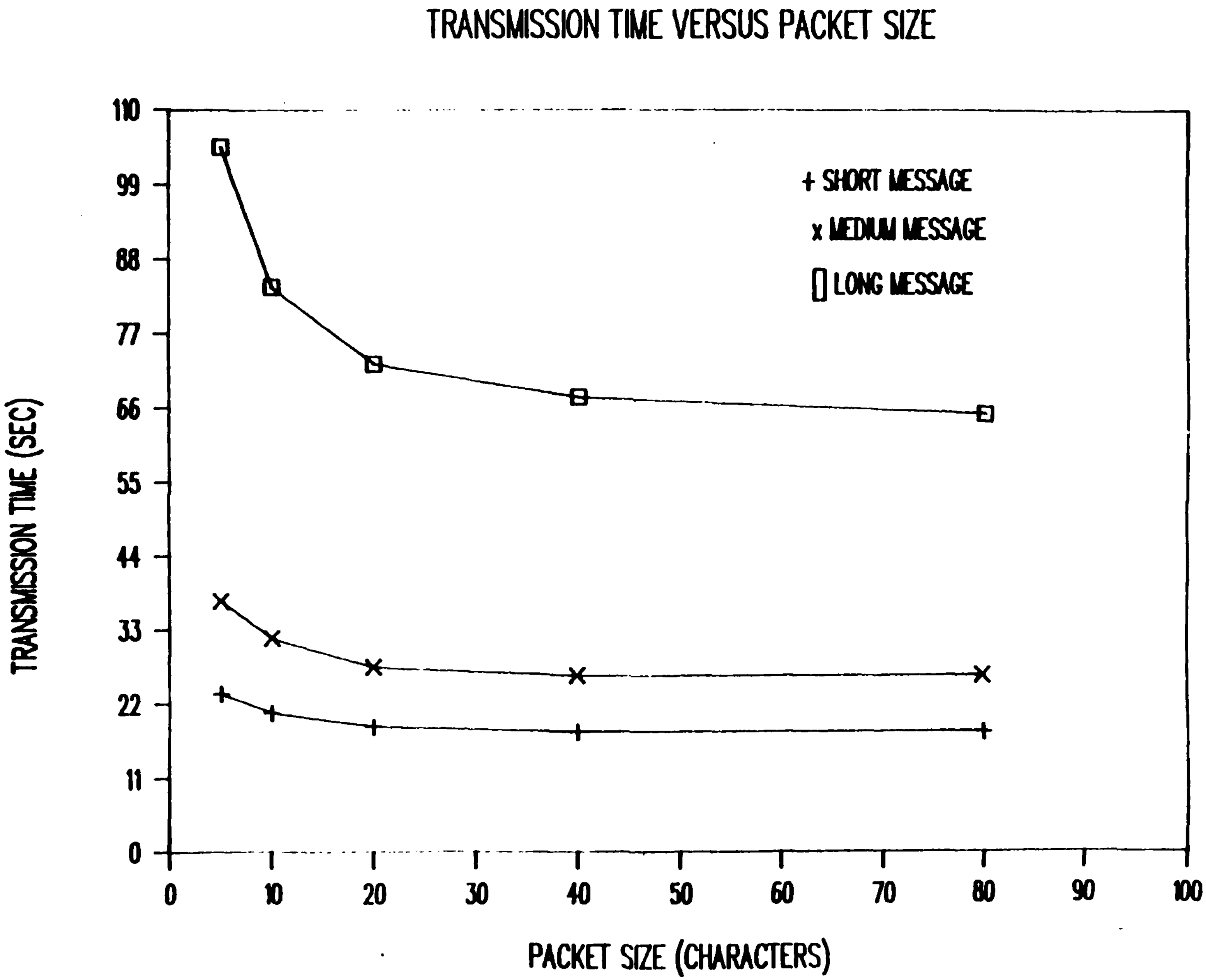


Figure B-1. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous

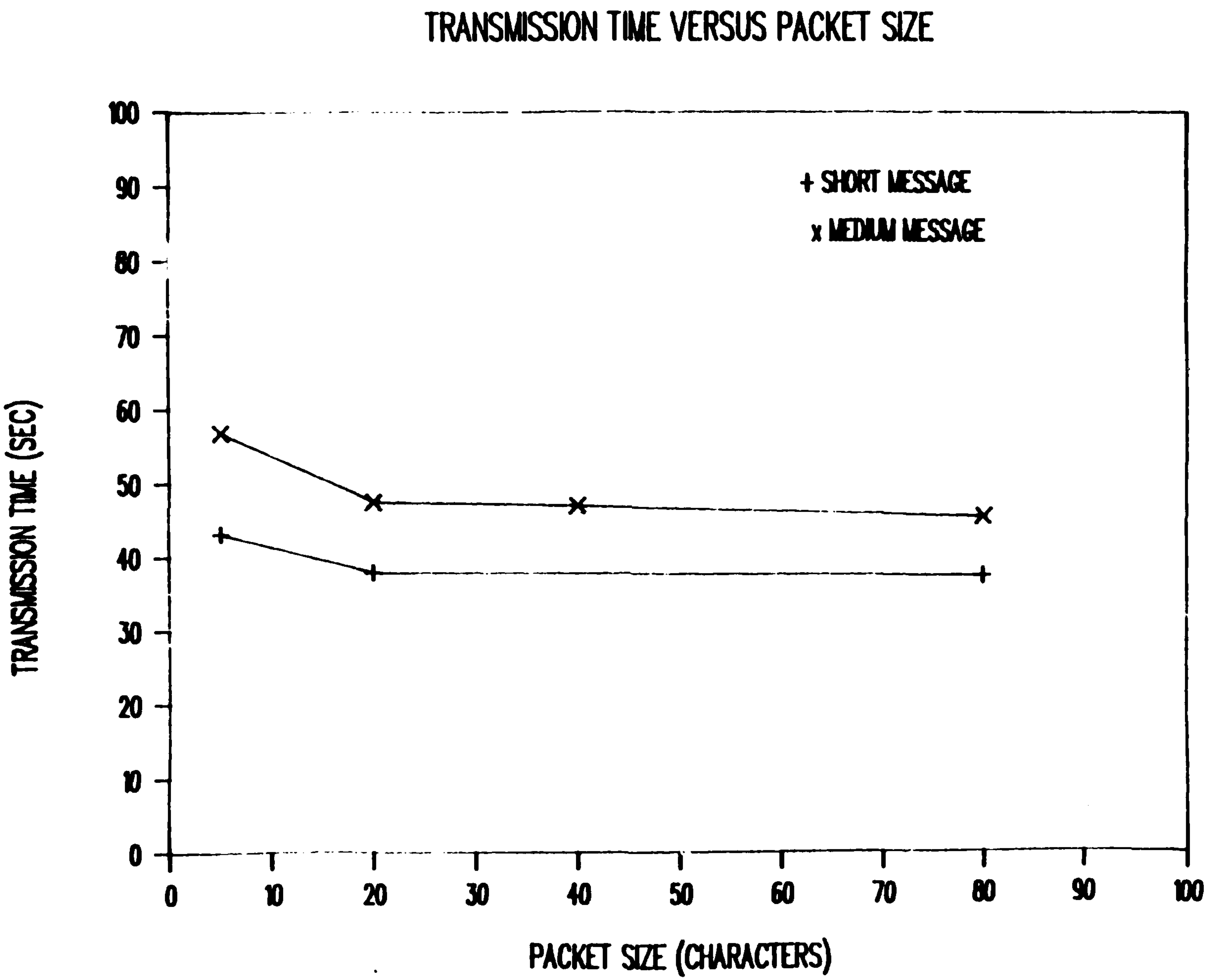


Figure B-2. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous

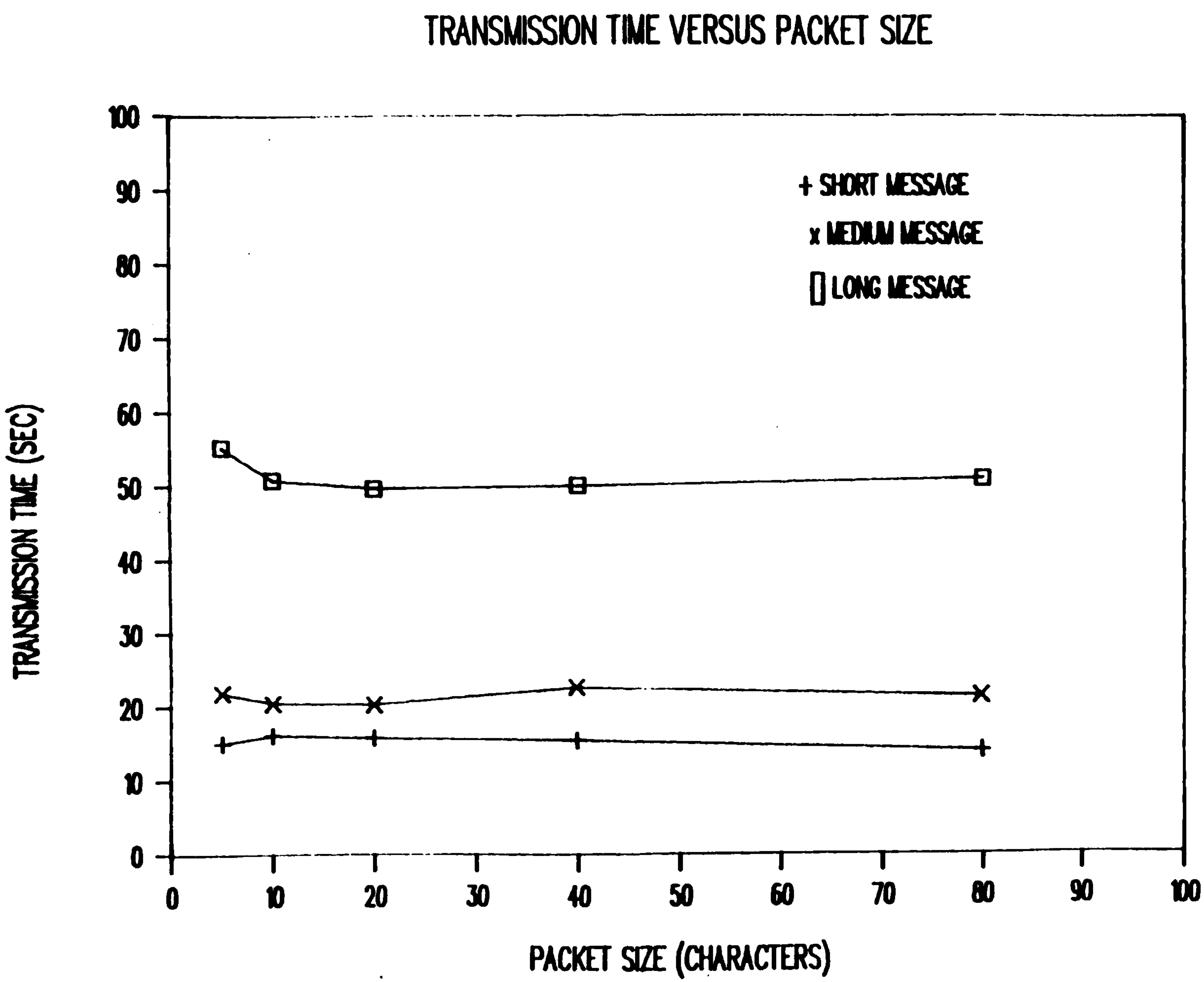


Figure B-3. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous

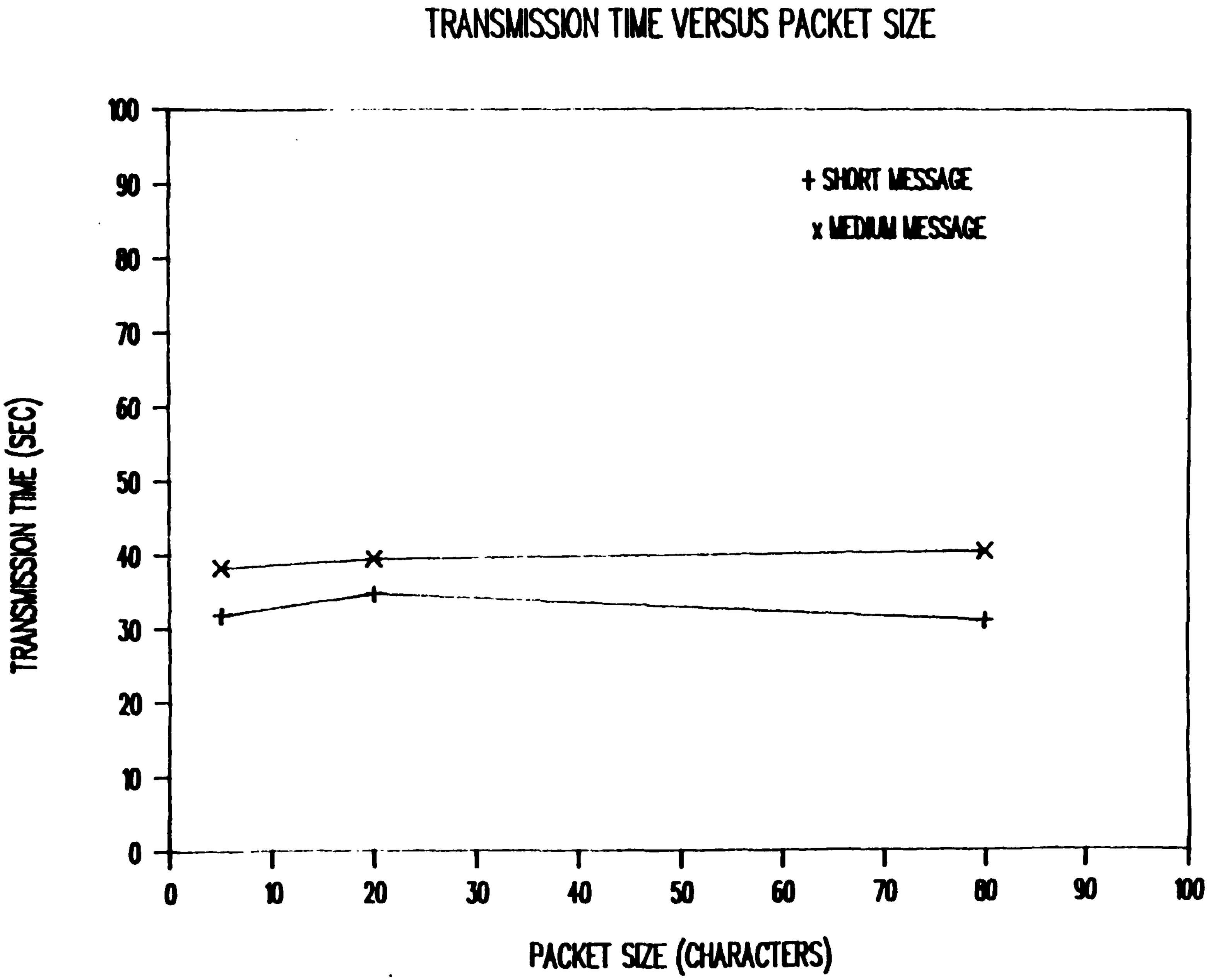


Figure B-4. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous

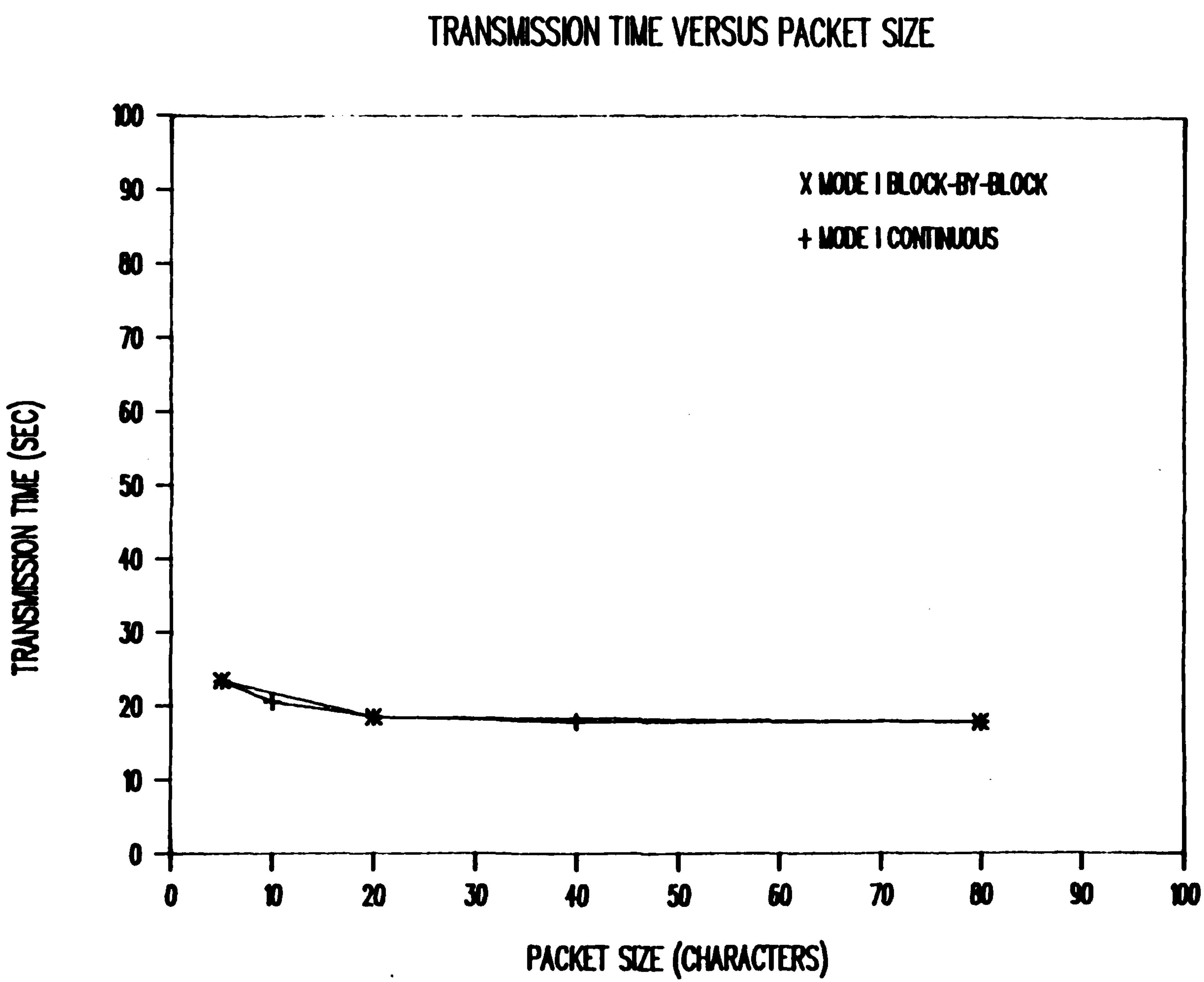


Figure B-5. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

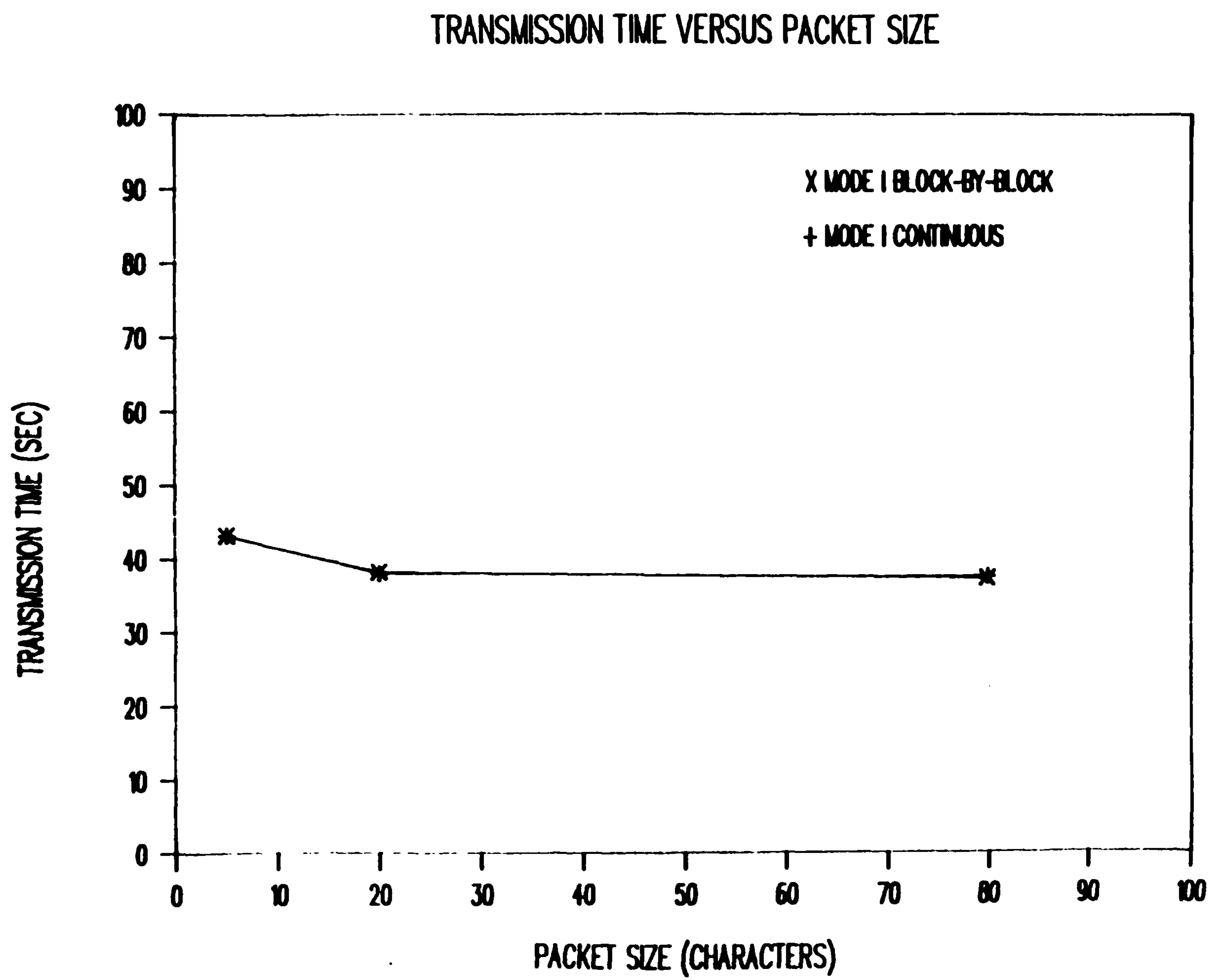


Figure B-6. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

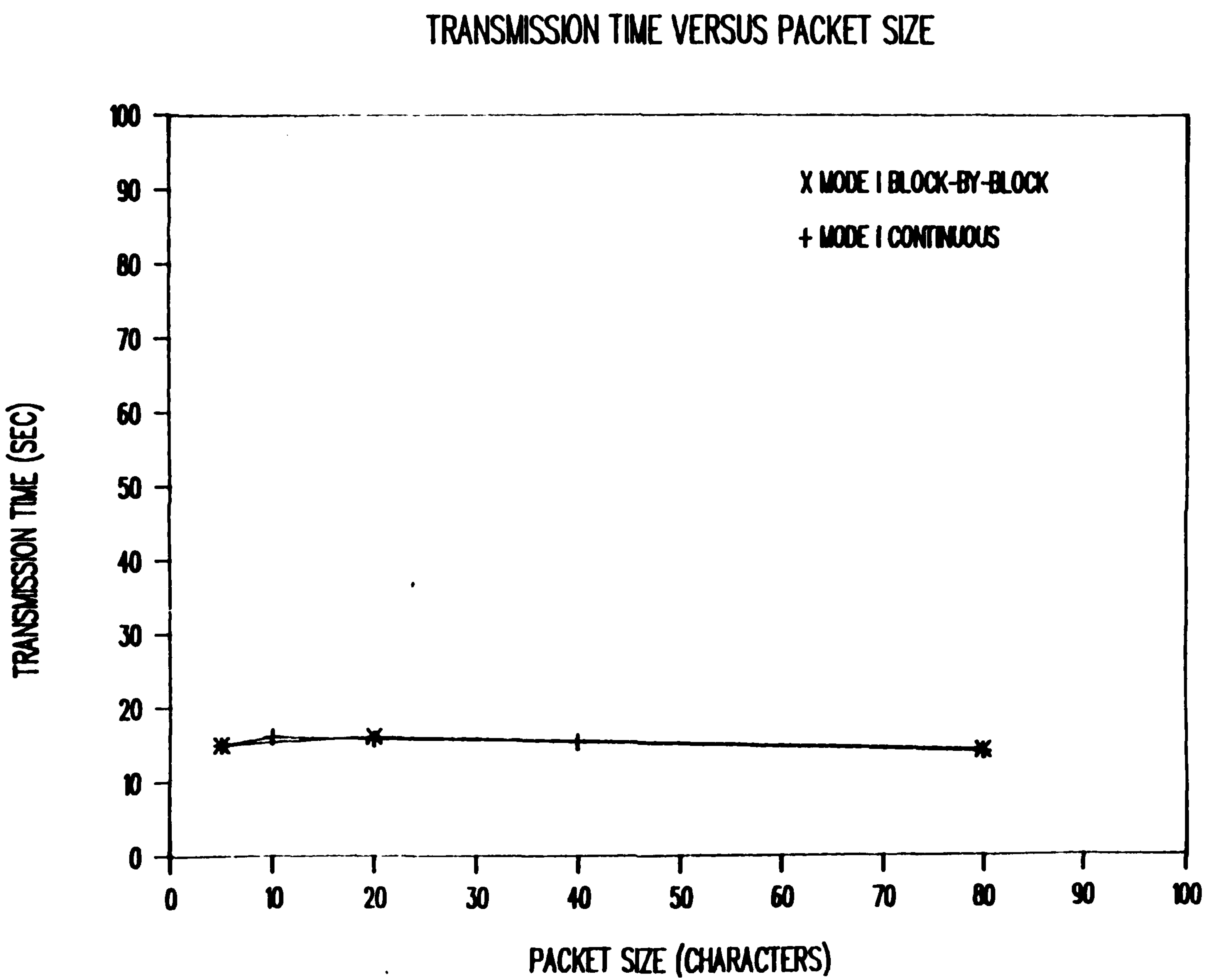


Figure B-7. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous and Block-by Block, Short Message

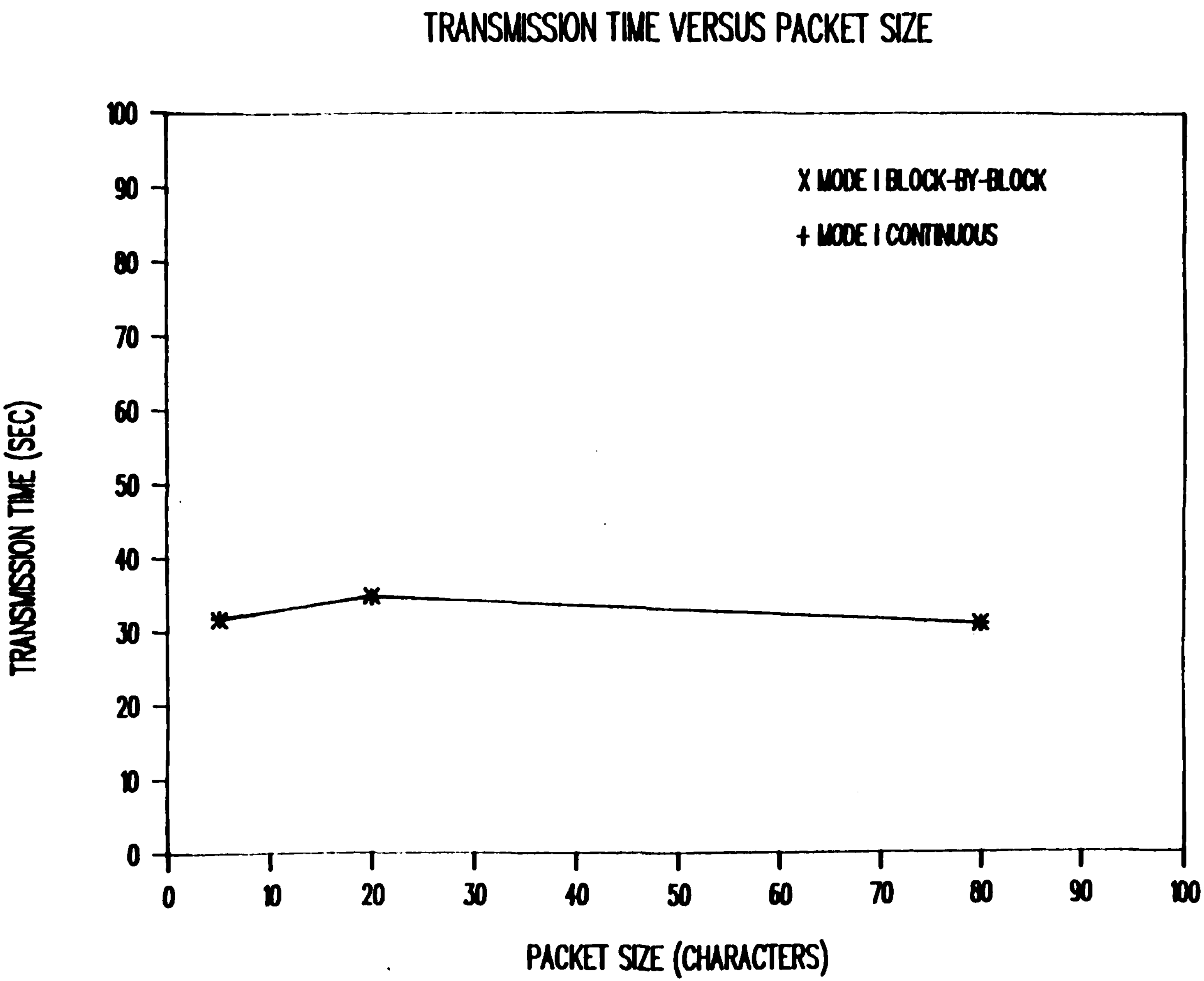


Figure B-8. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

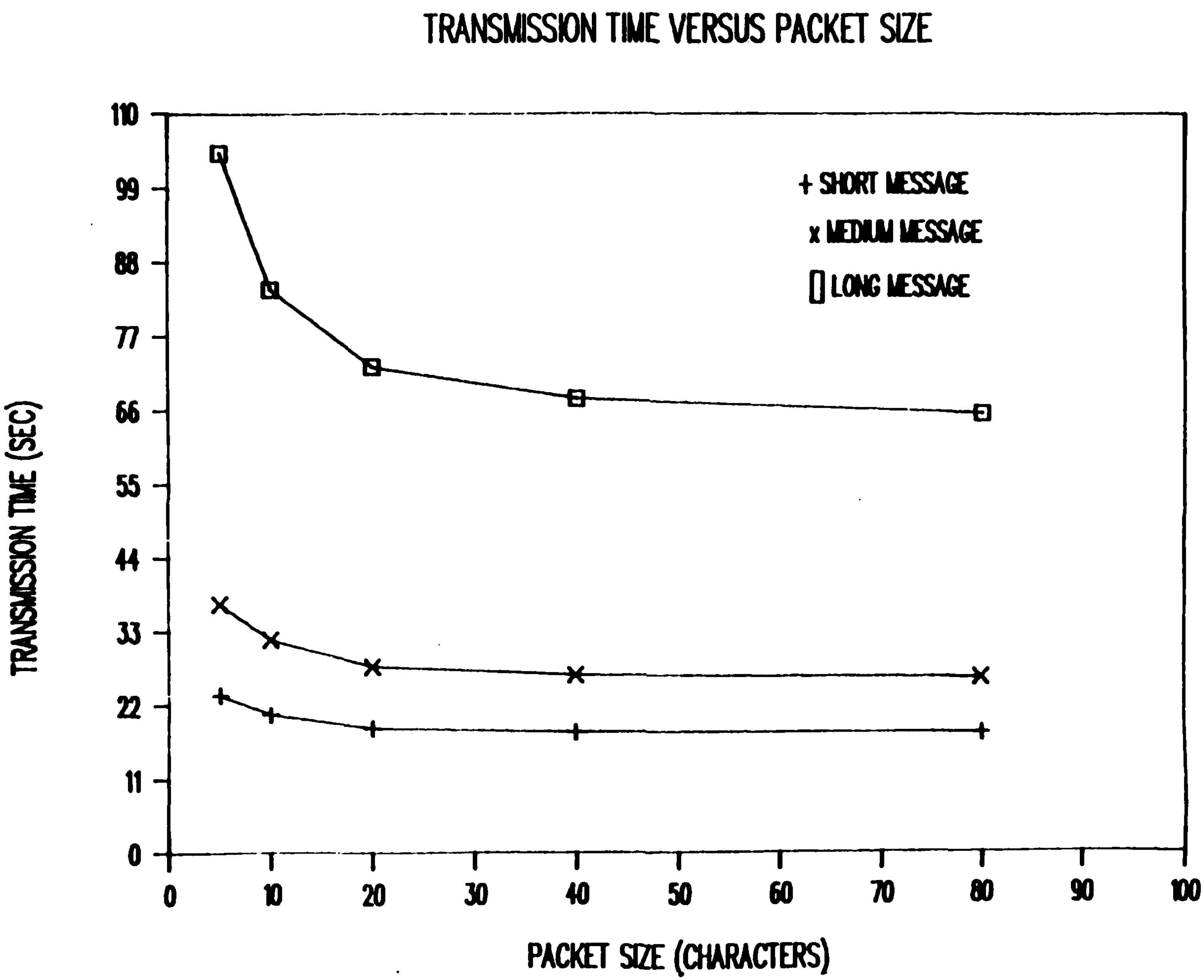


Figure B-9. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous

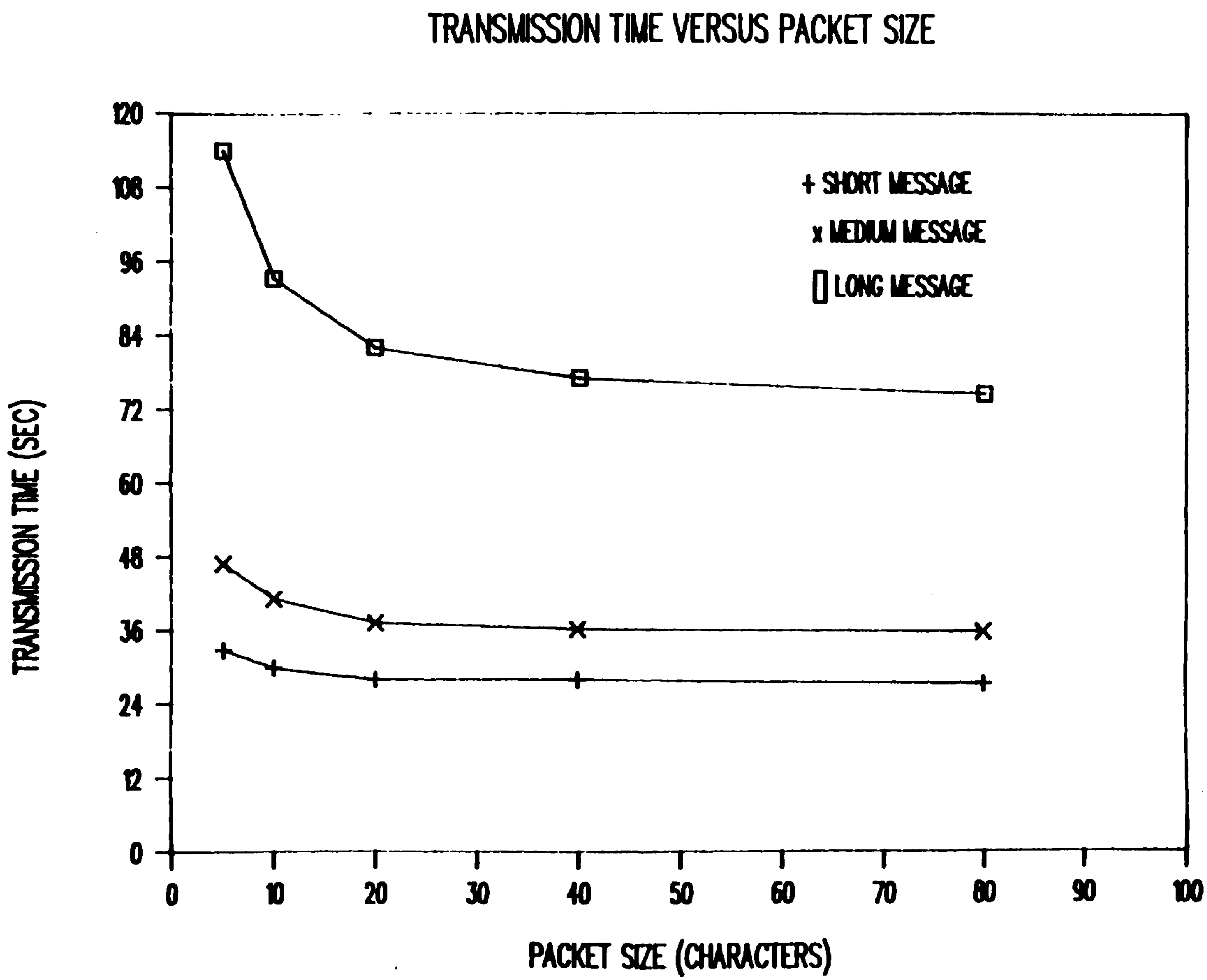


Figure B-10. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous

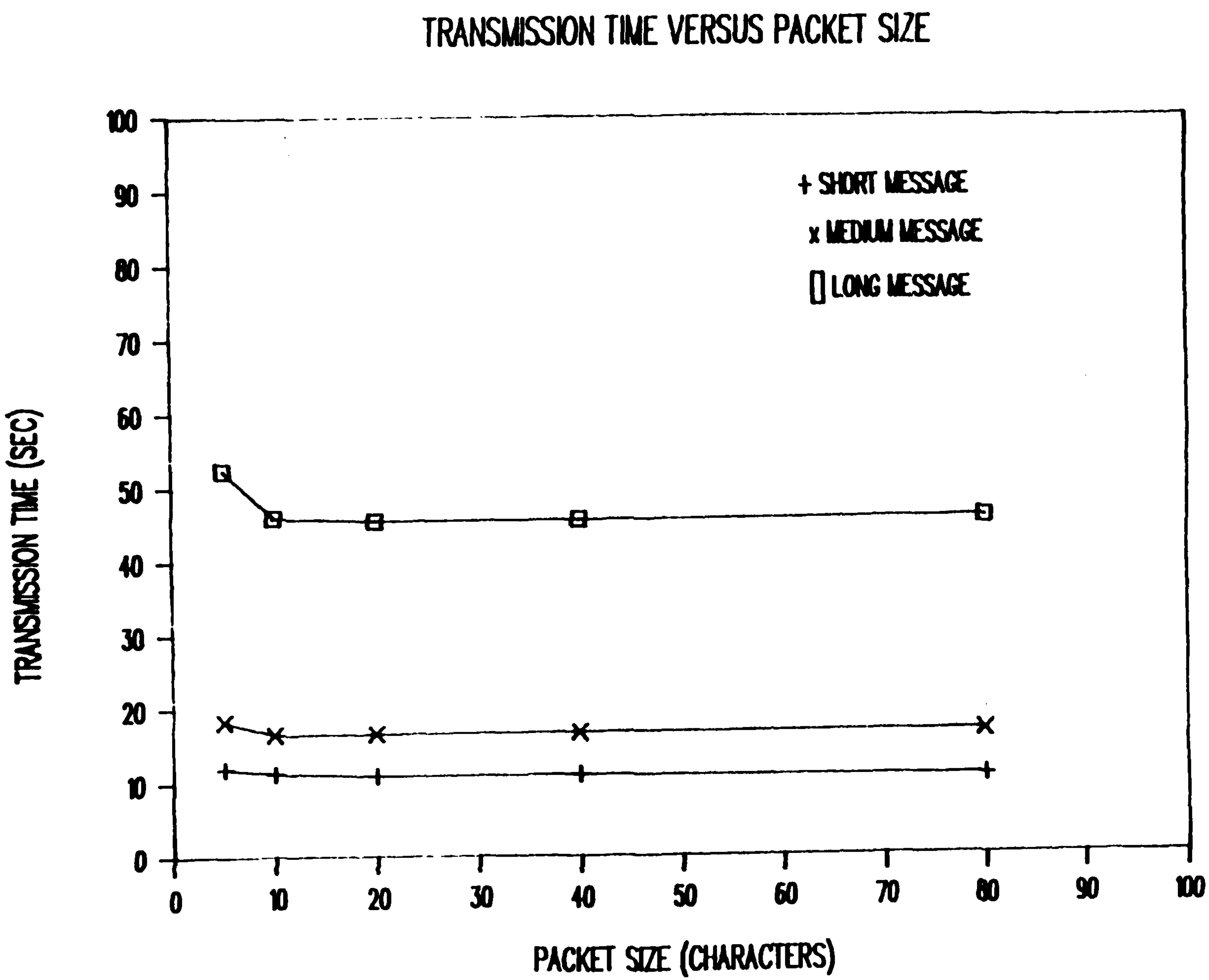


Figure B-11. MD-1061 Modem, 2400 b/s, 0 Second Interleaver Delay, Mode I Continuous

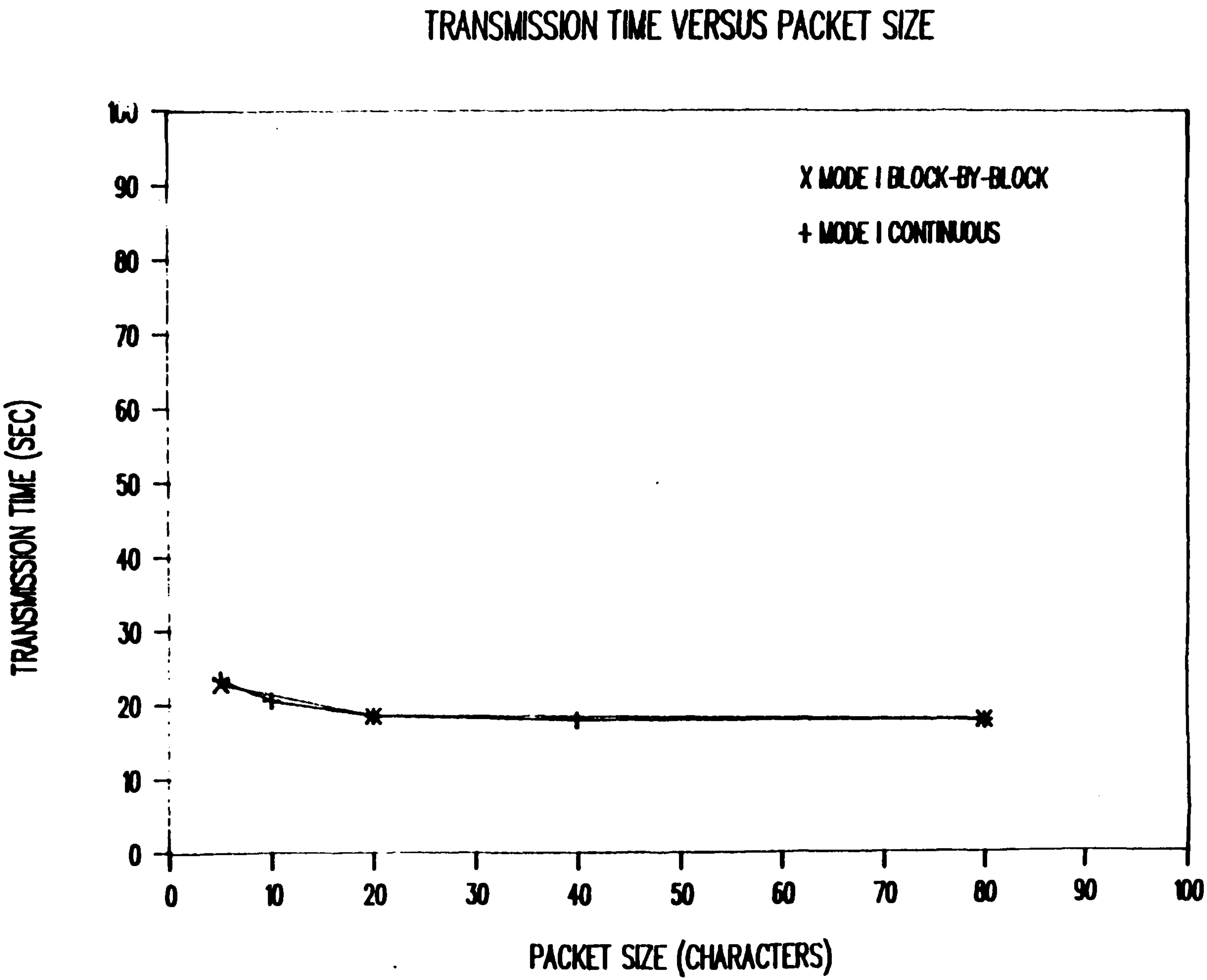


Figure B-12. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

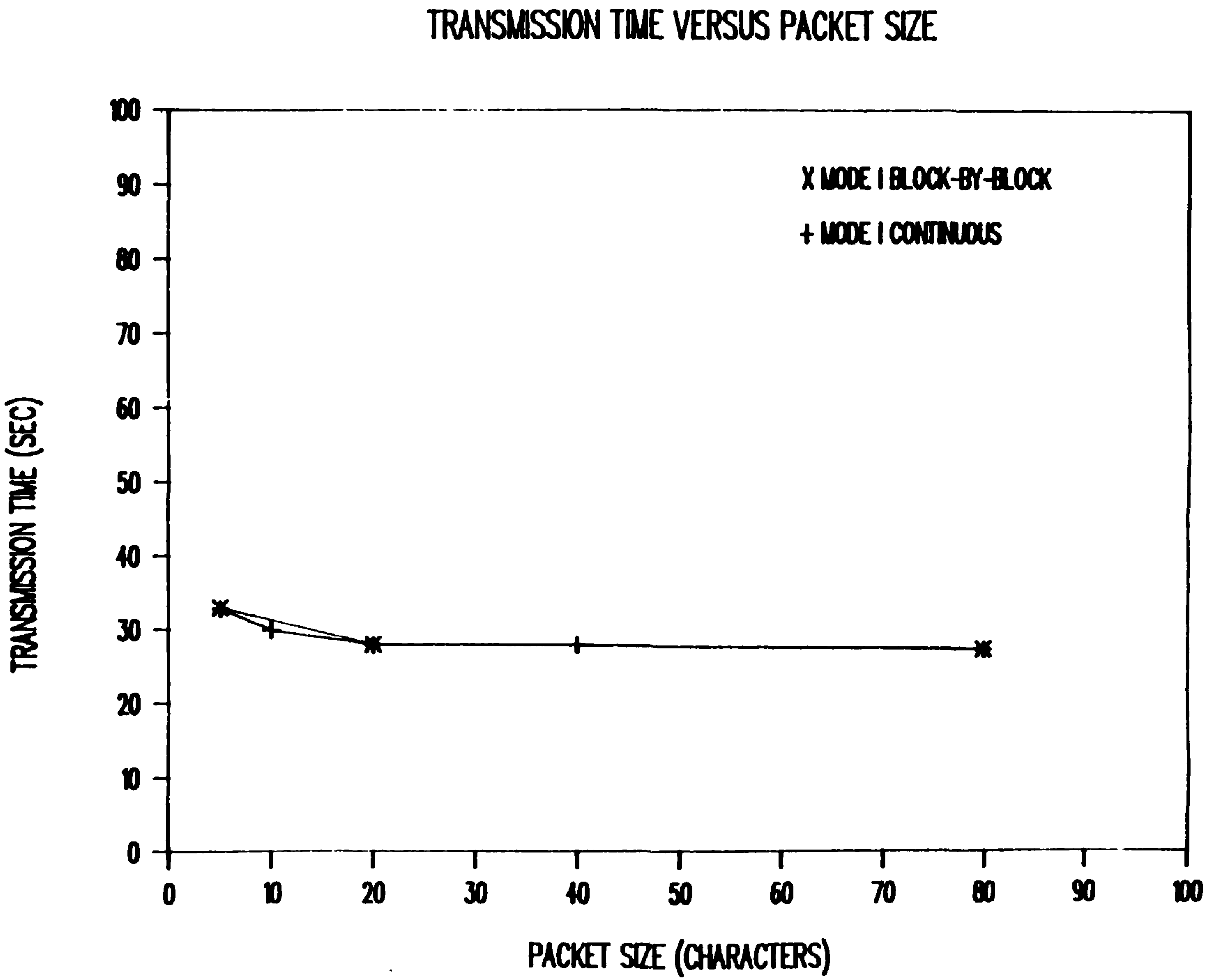


Figure B-13. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

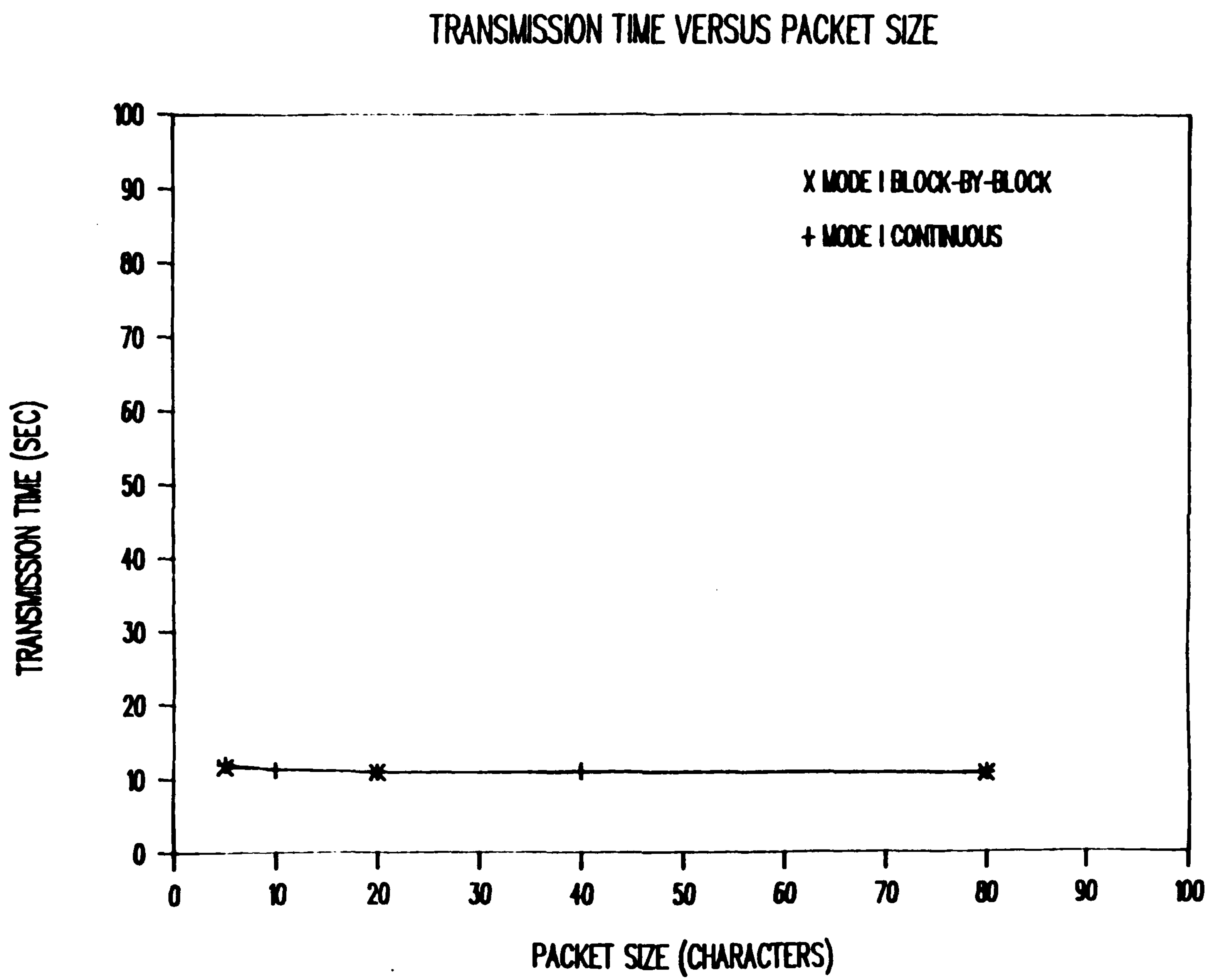


Figure B-14. MD-1061 Modem, 2400 b/s, 0 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

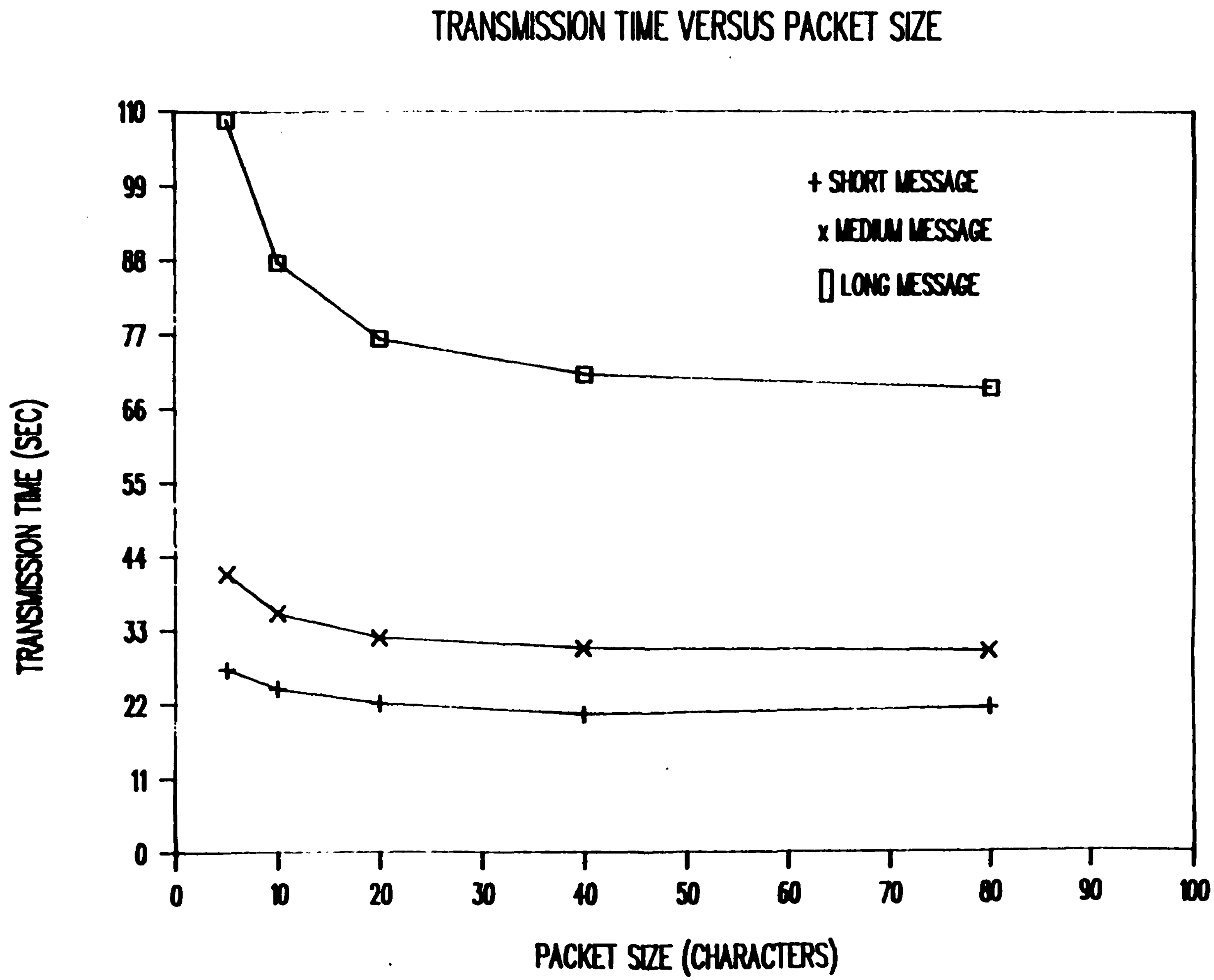


Figure B-15. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous

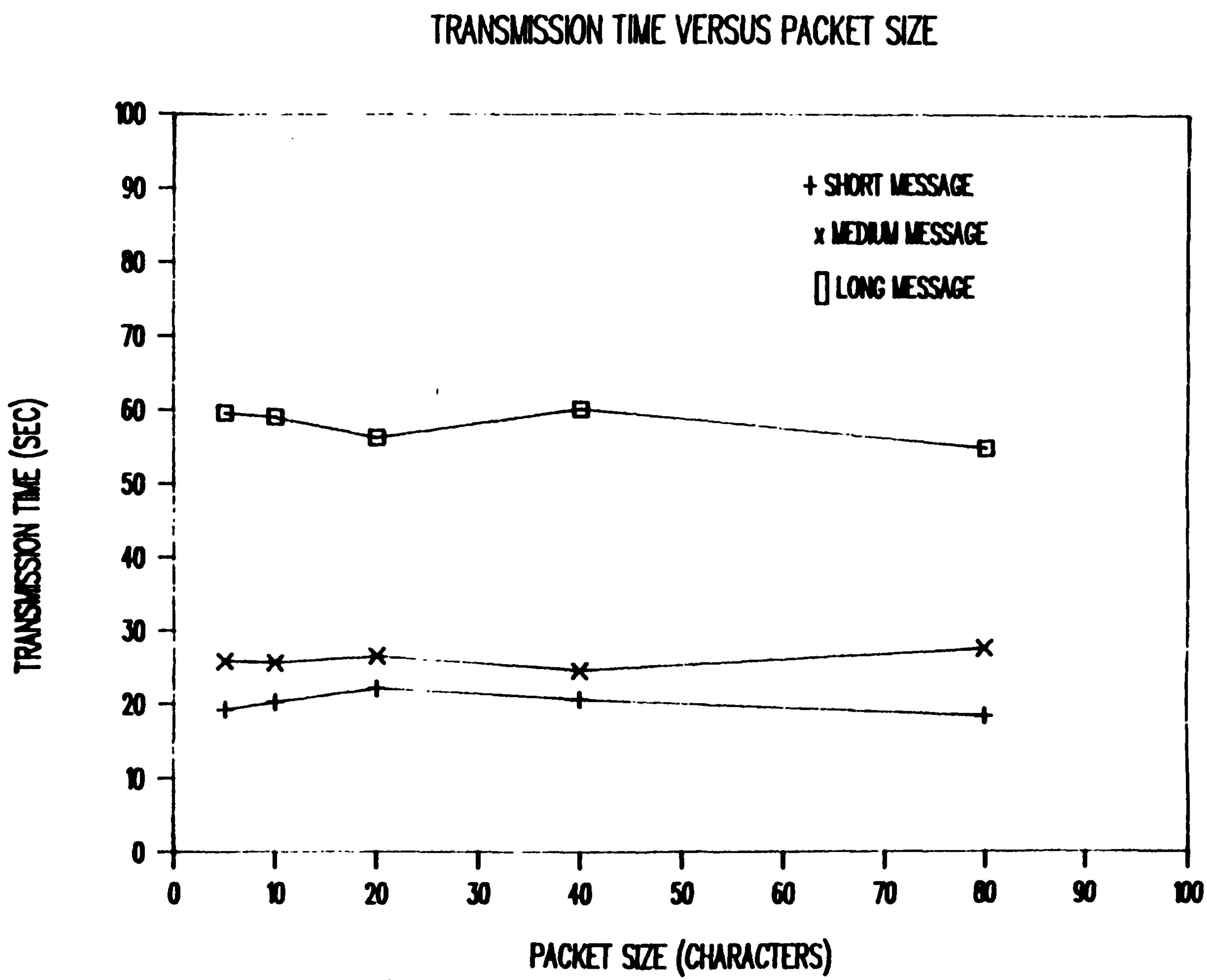


Figure B-16. HSM-1A Modem, 2400 b/s, 3.5 Second Interleaver Delay, Mode I Continuous

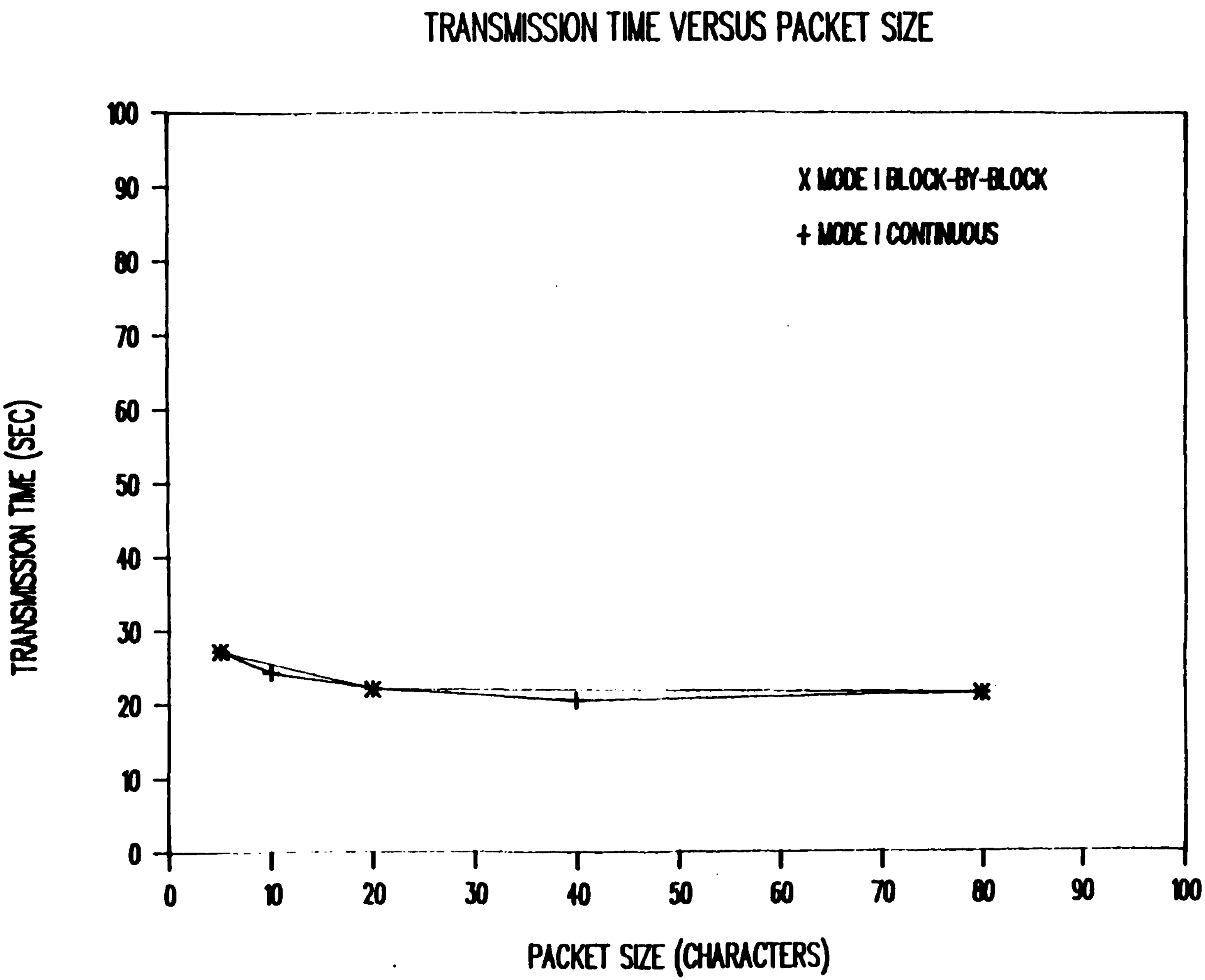


Figure B-17. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

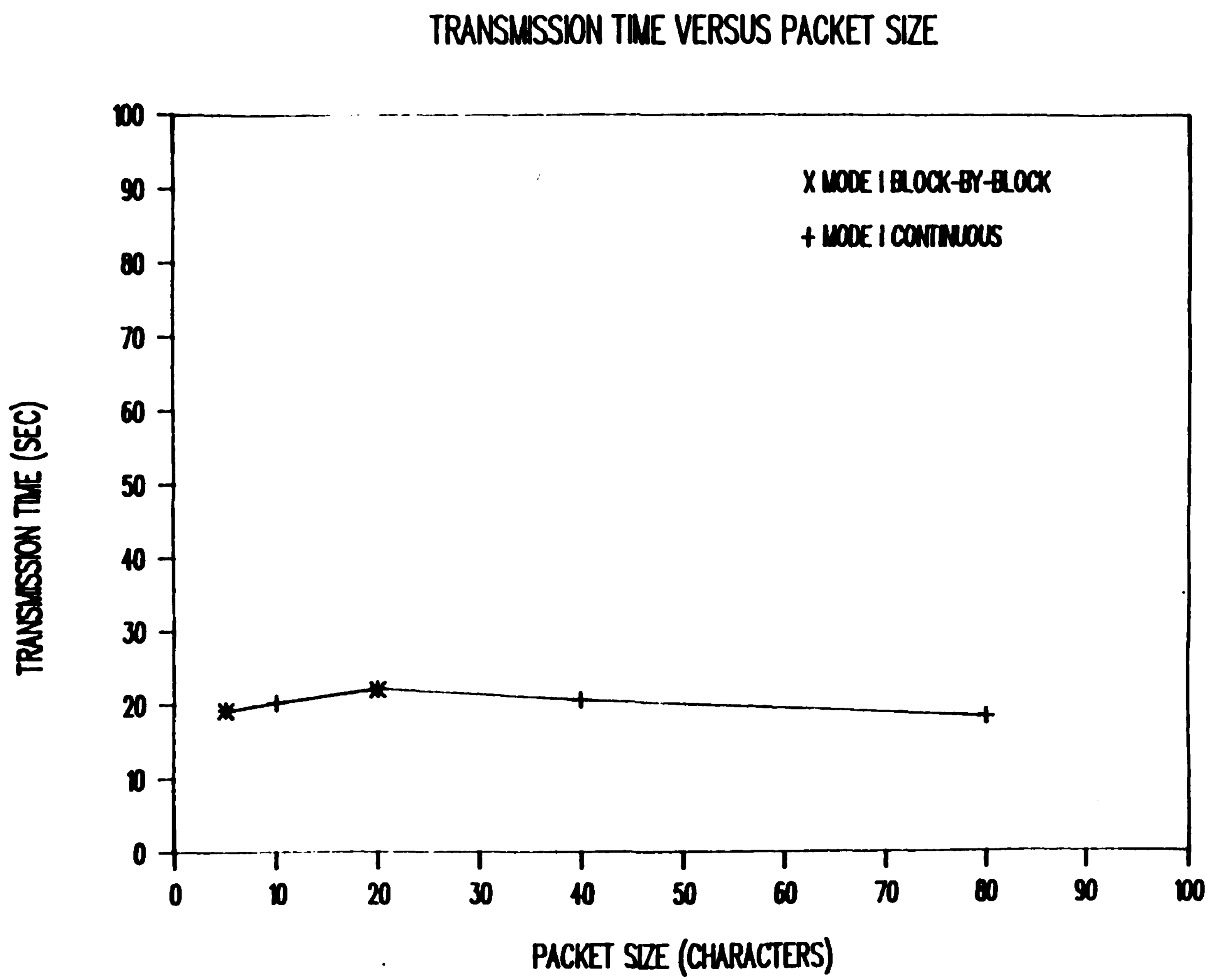


Figure B-18. HSM-1A Modem, 2400 b/s, 3.5 Second Interleaver Delay, Mode I Continuous and Block-by-Block, Short Message

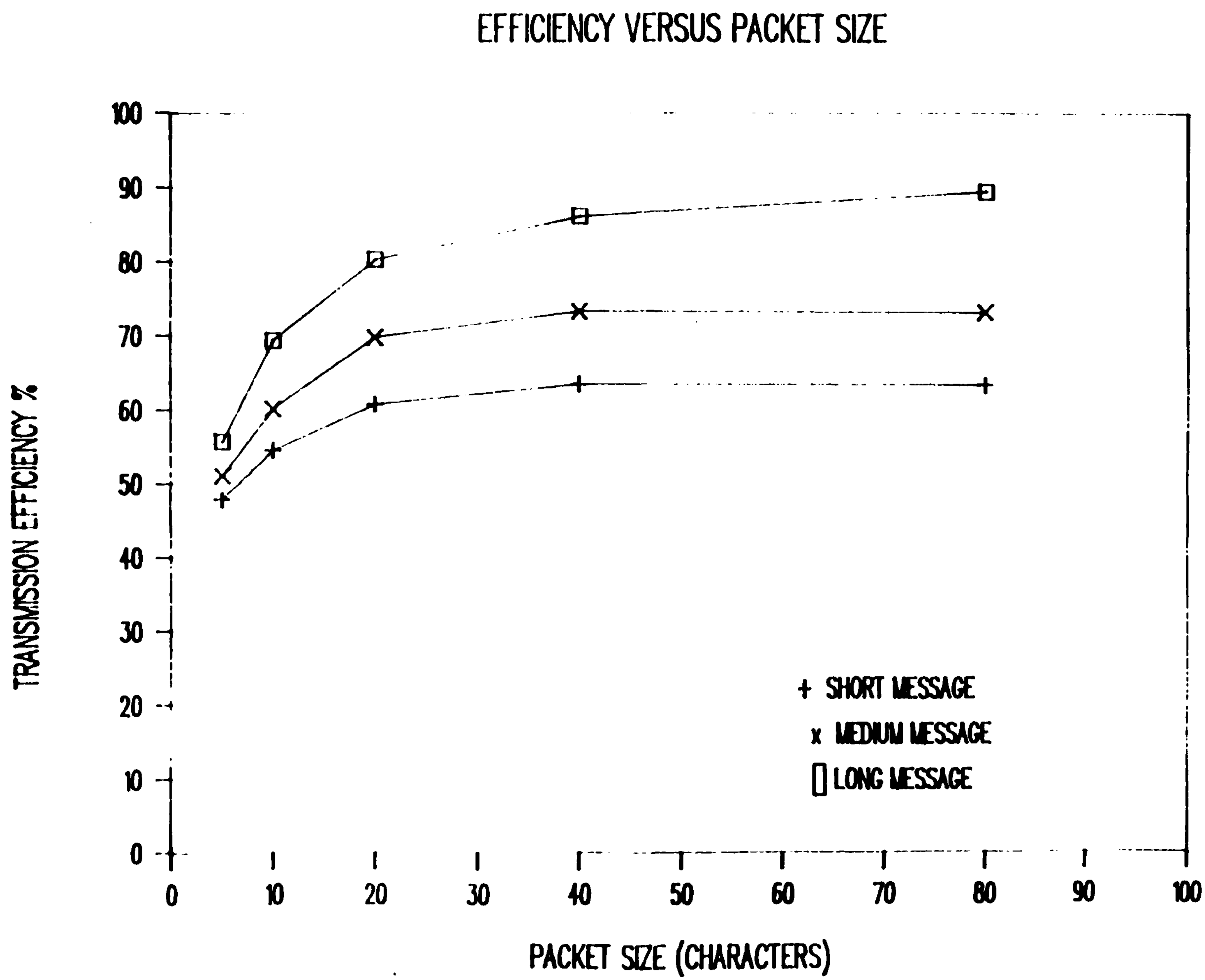


Figure B-19. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous

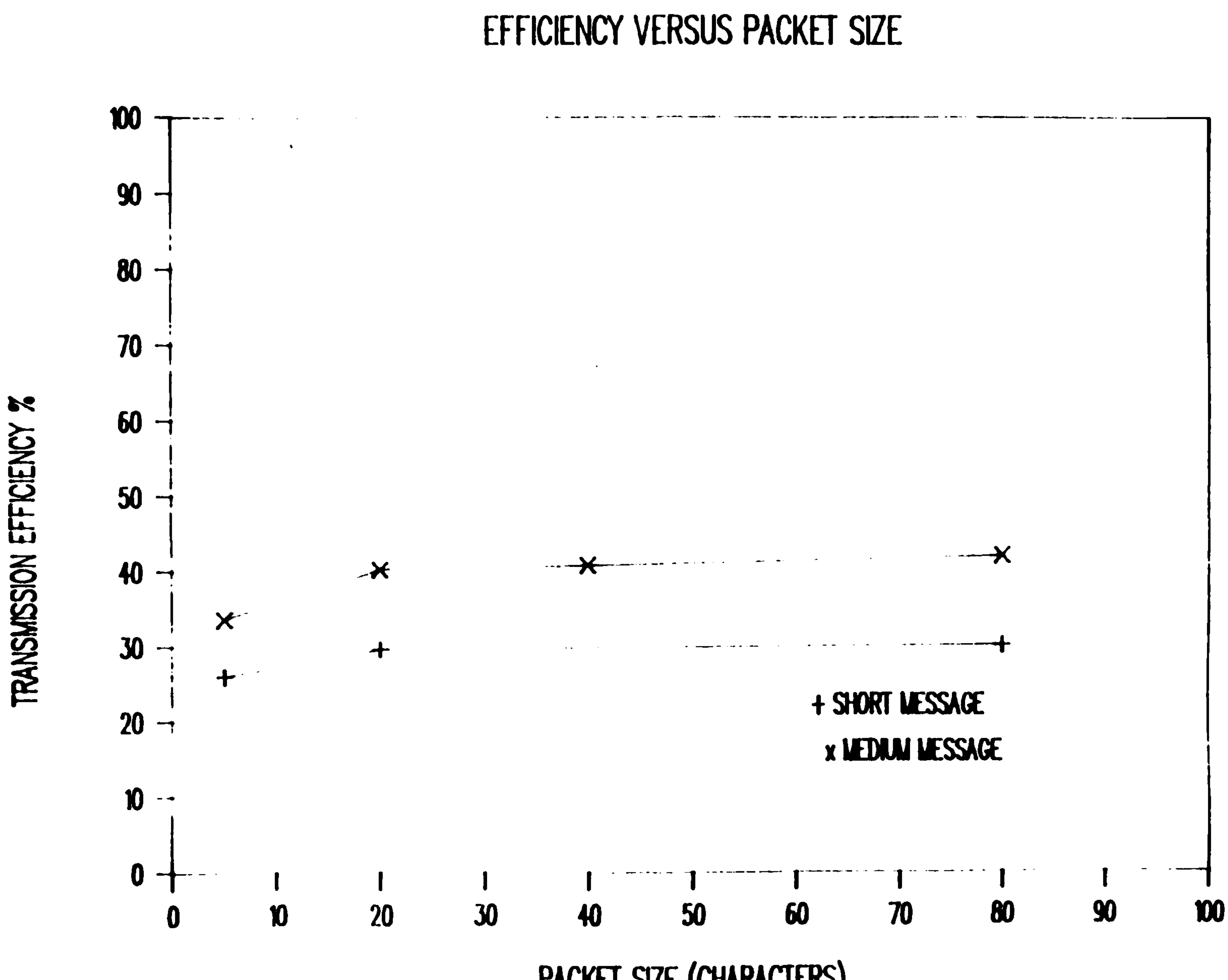


Figure B-20. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous

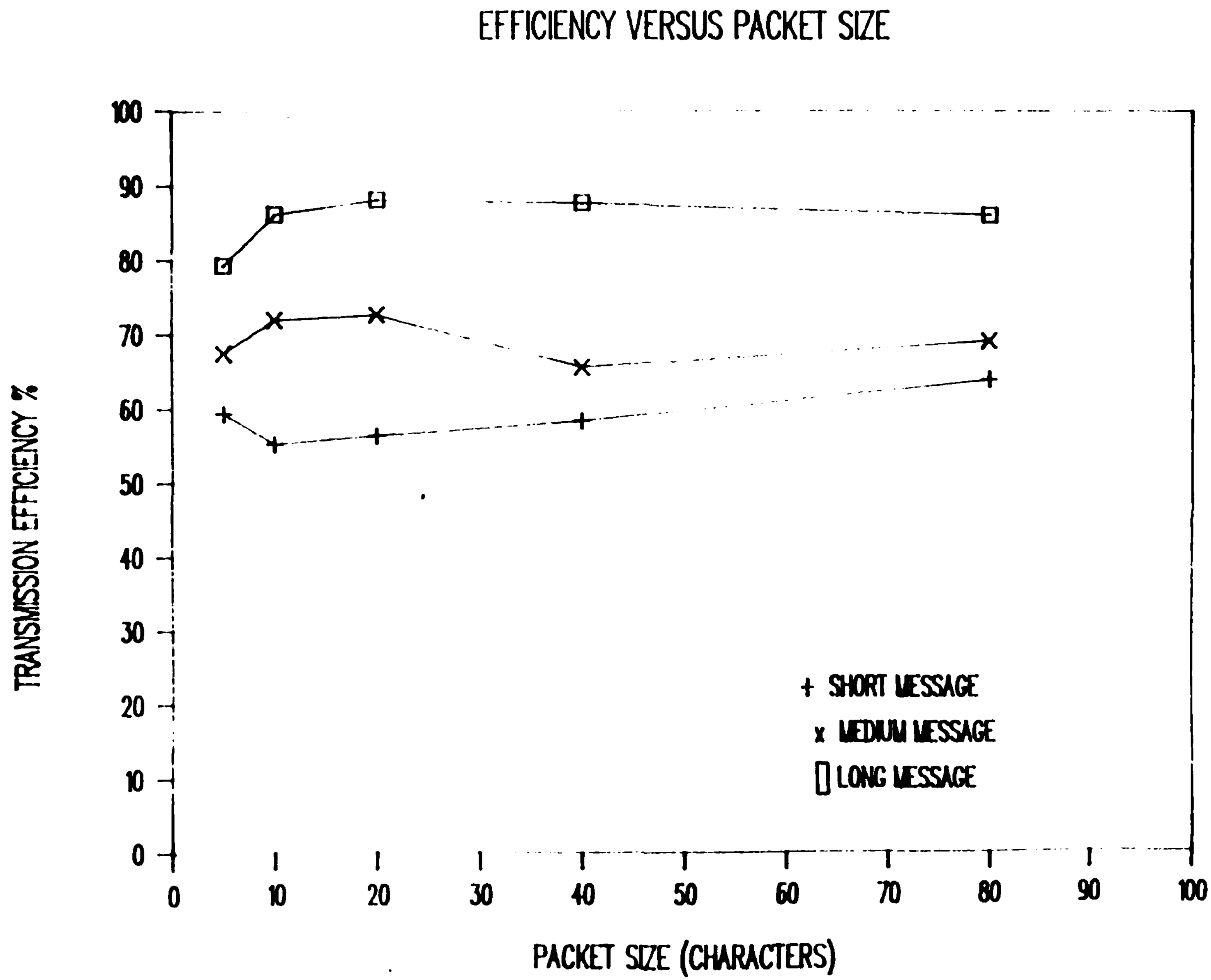


Figure B-21. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous

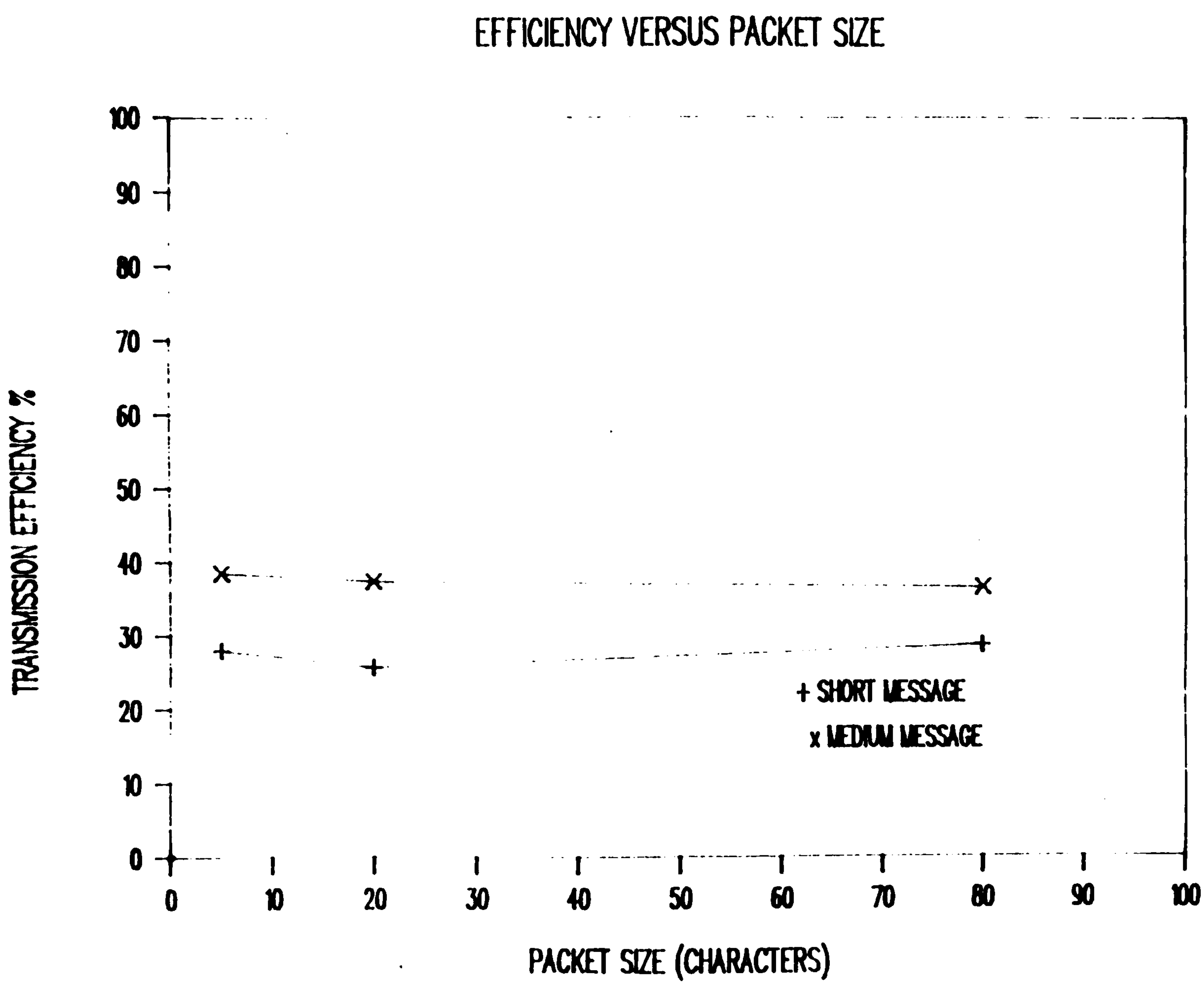


Figure B-22. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous

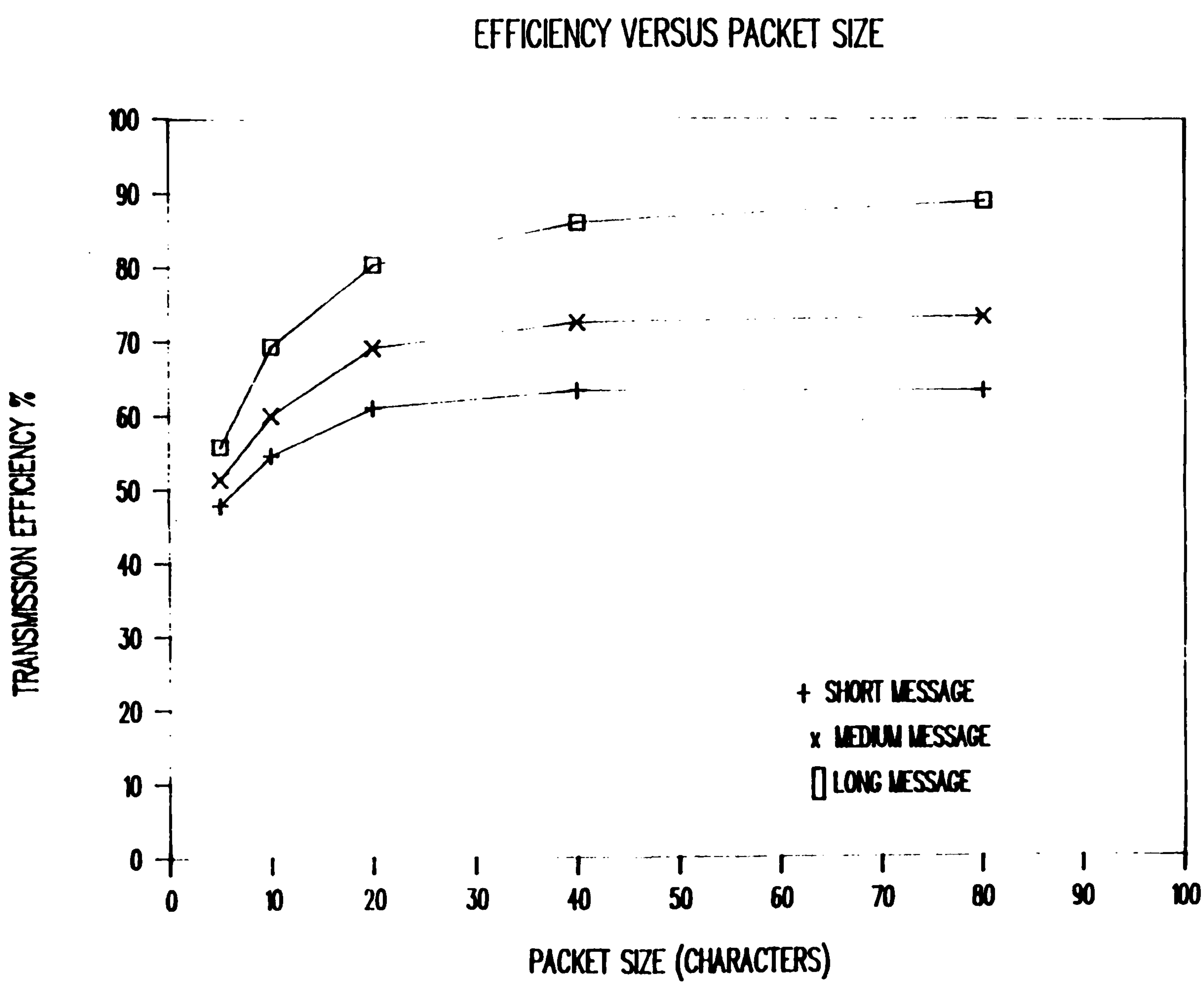


Figure B-23. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous

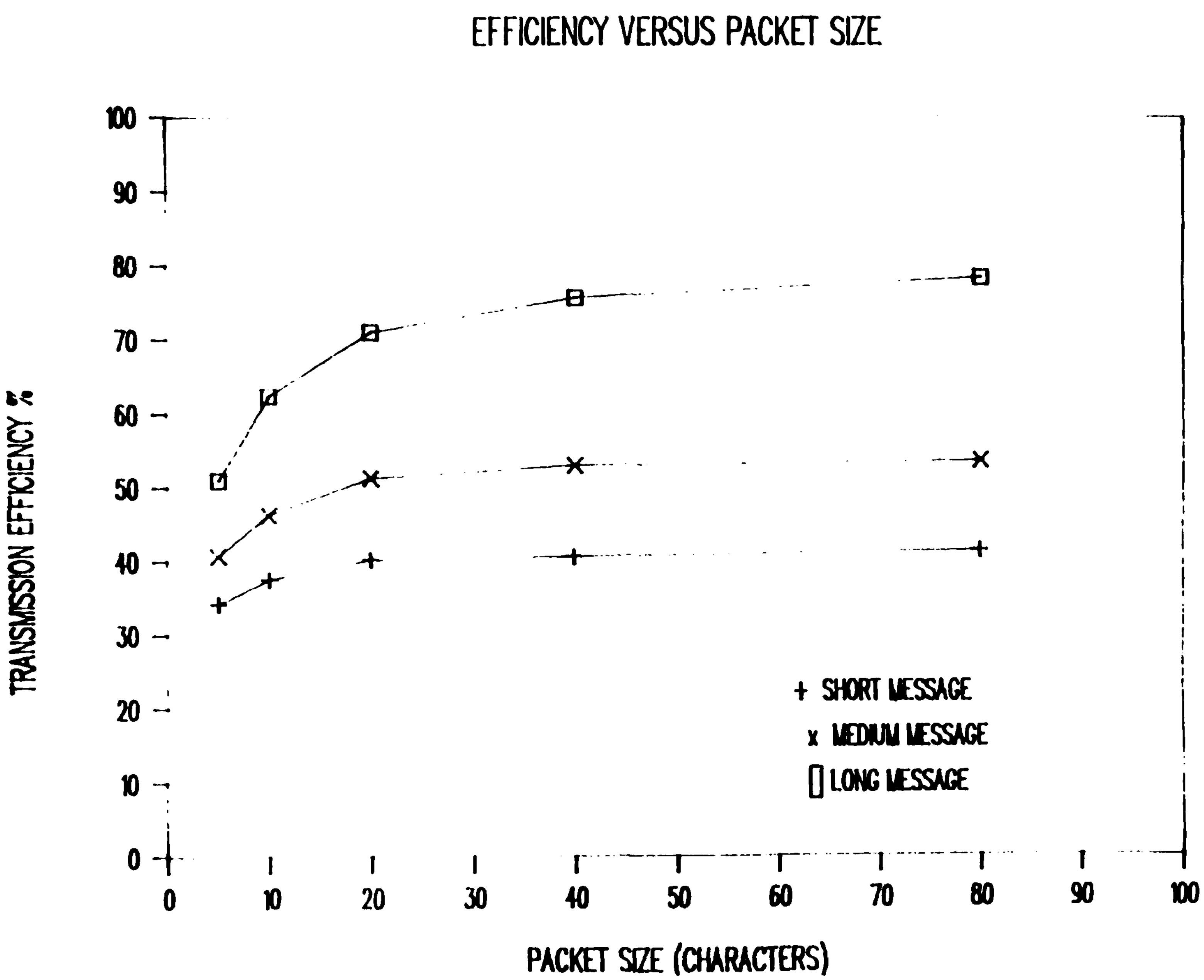


Figure B-24. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous

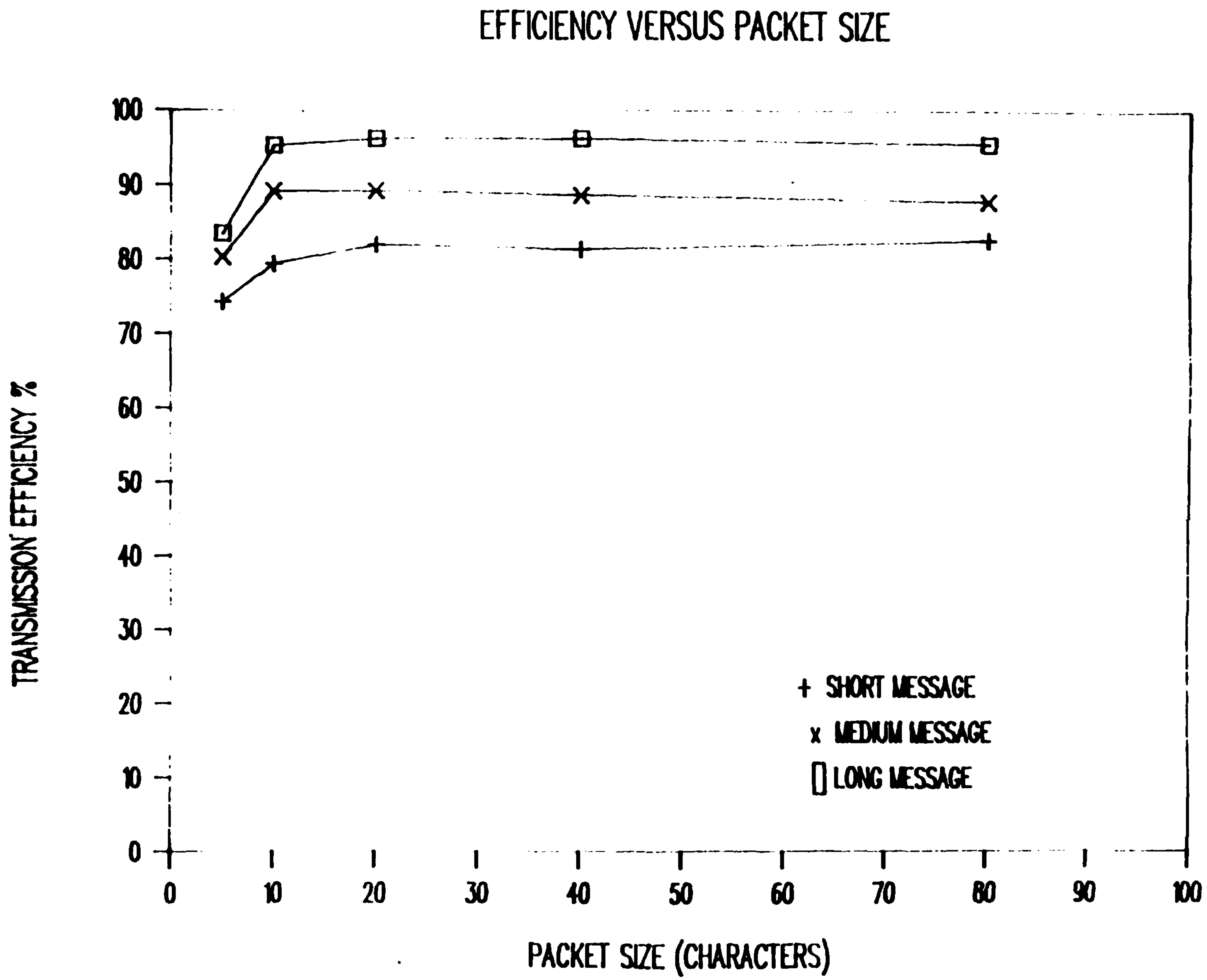


Figure B-25. MD-1061 Modem, 2400 b/s, 0 Second Interleaver Delay, Mode I Continuous

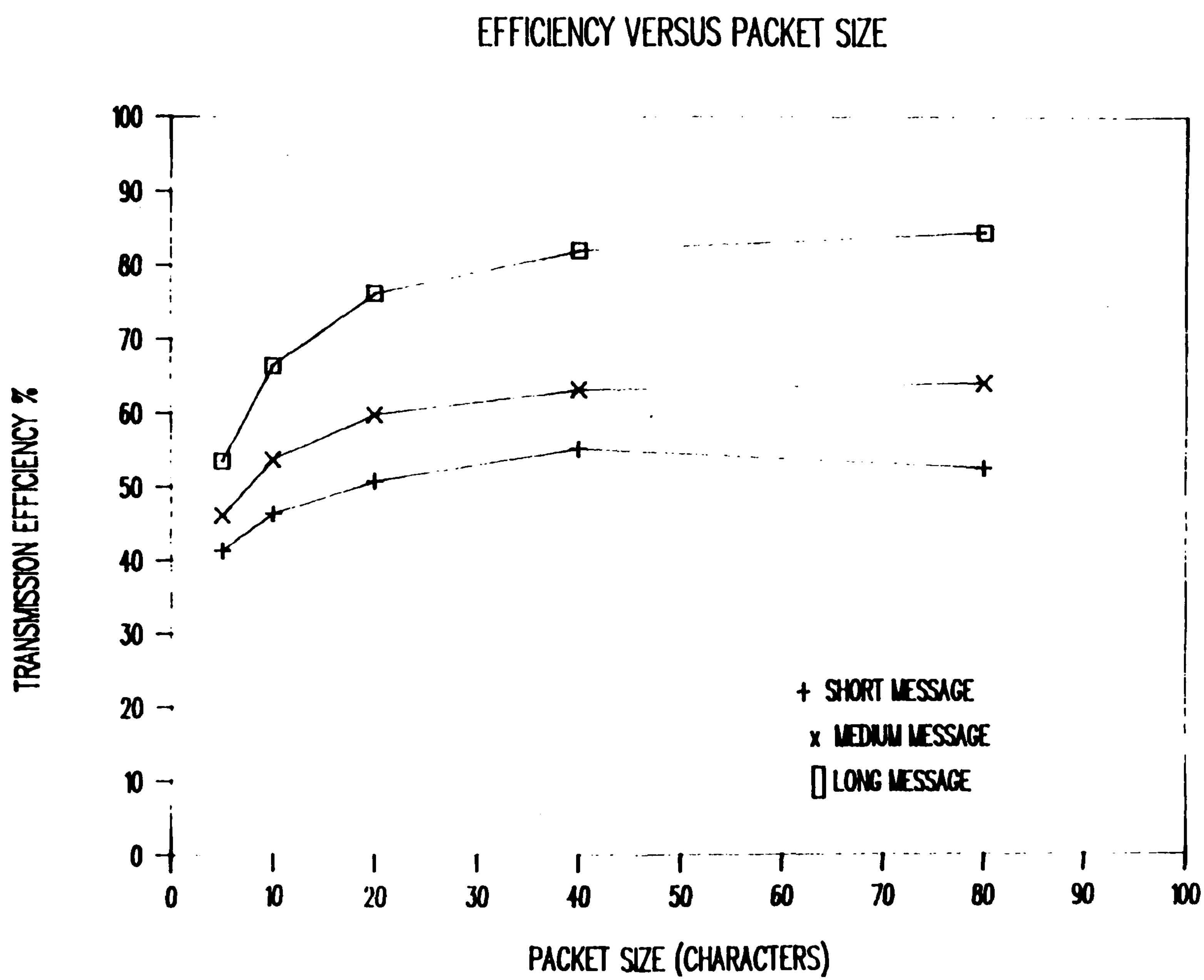


Figure B-26. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous

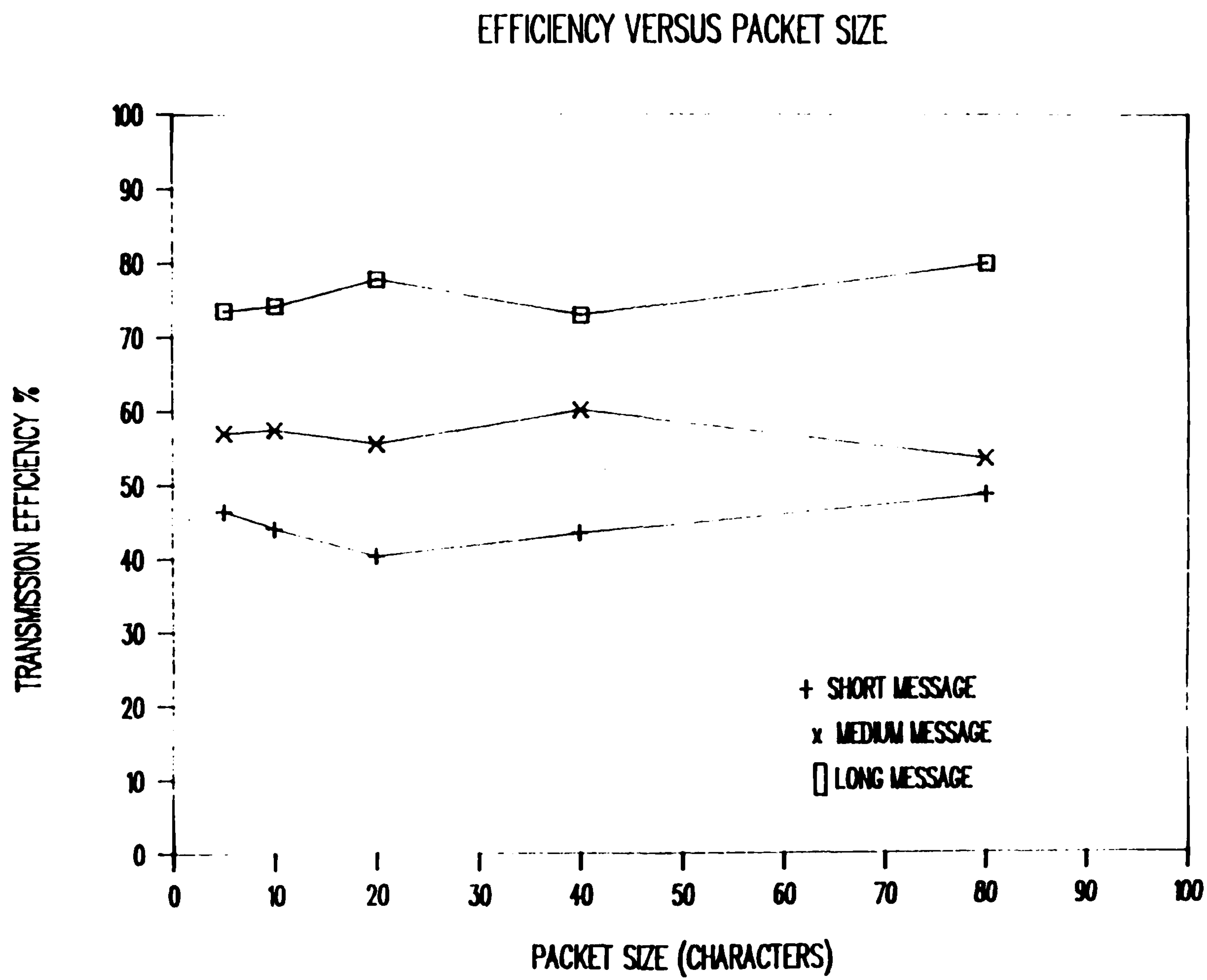


Figure B-27. HSM-1A Modem, 2400 b/s, 3.5 Second Interleaver Delay, Mode I Continuous

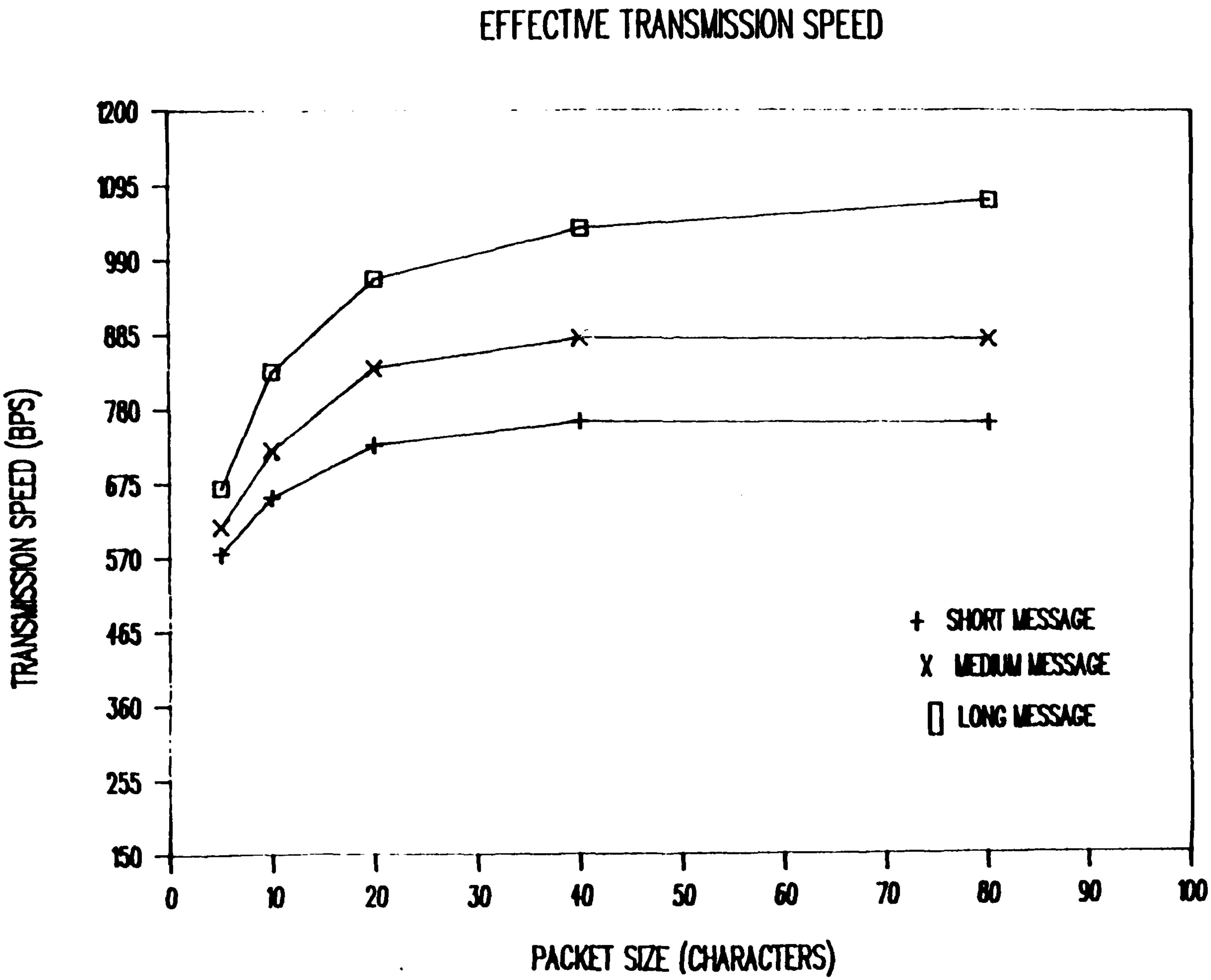


Figure B-28. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous

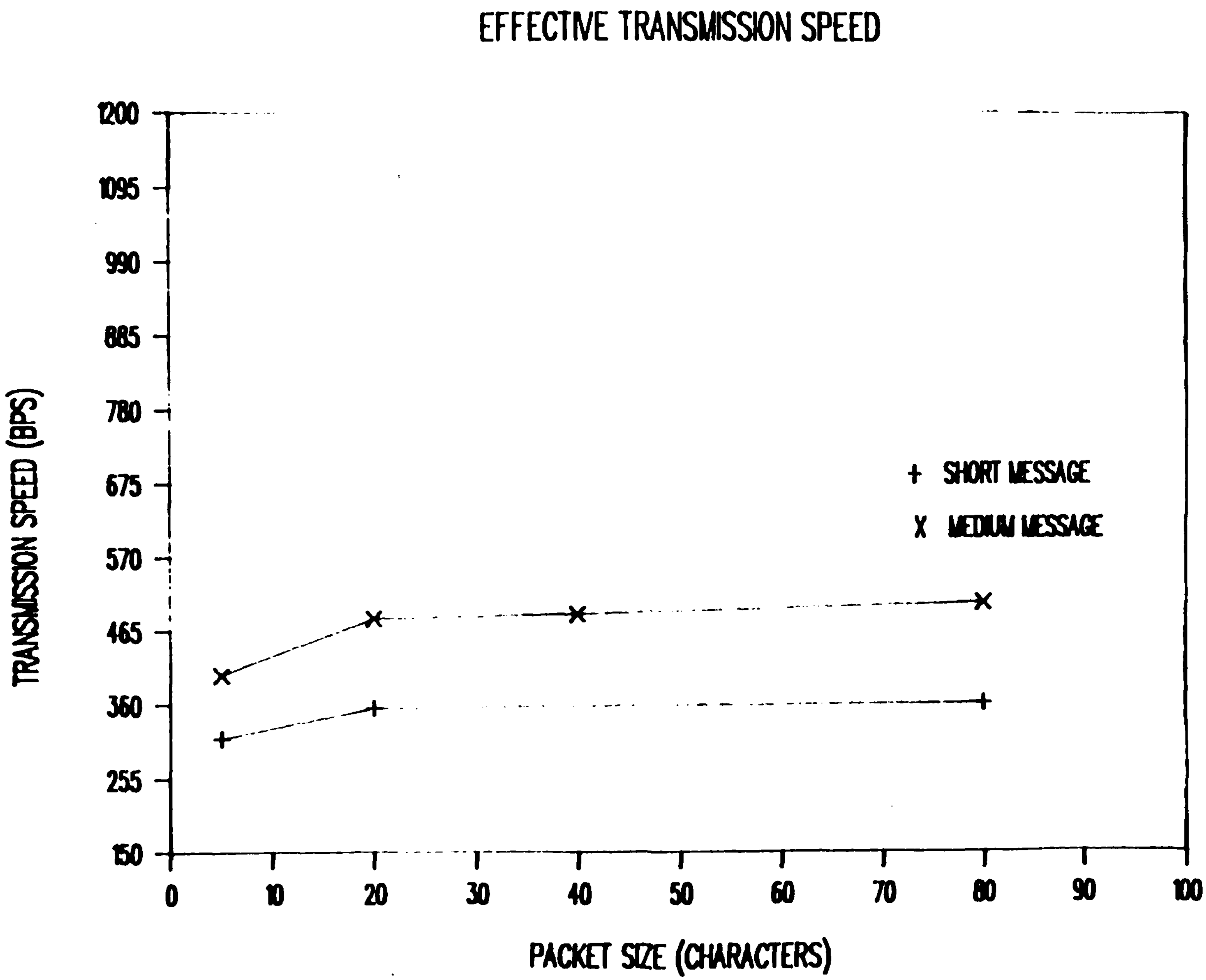


Figure B-29. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous

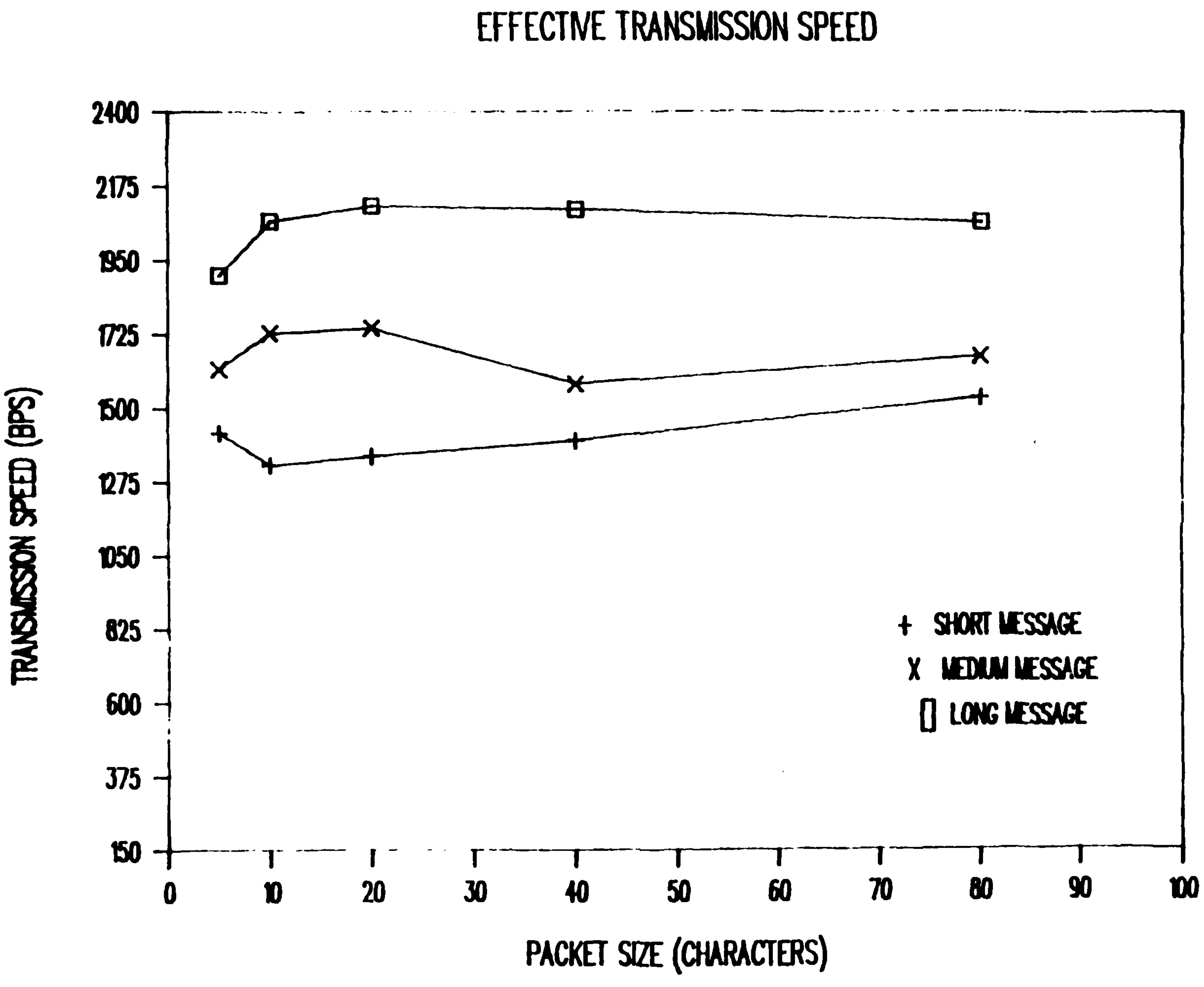


Figure B-30. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous

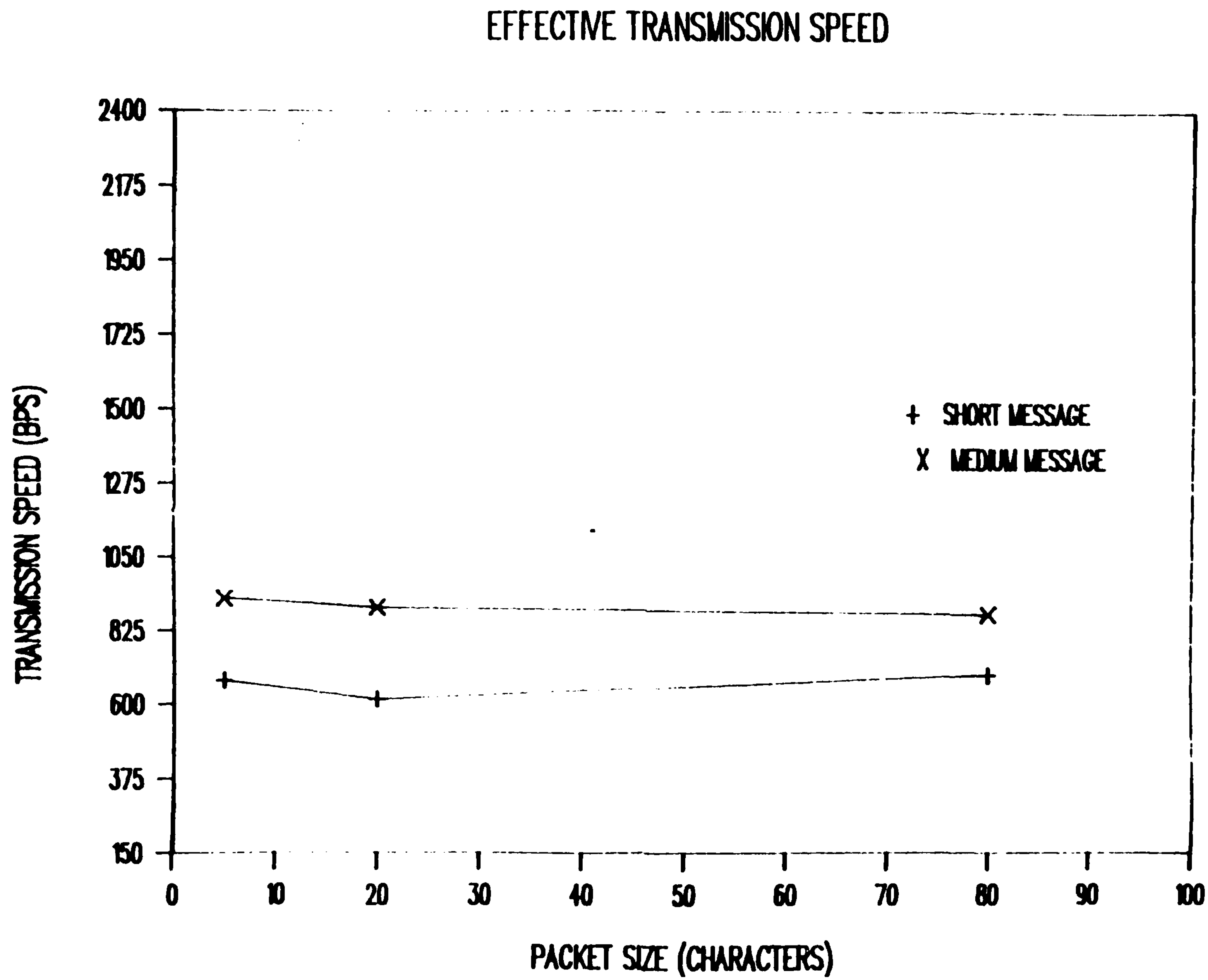


Figure B-31. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous

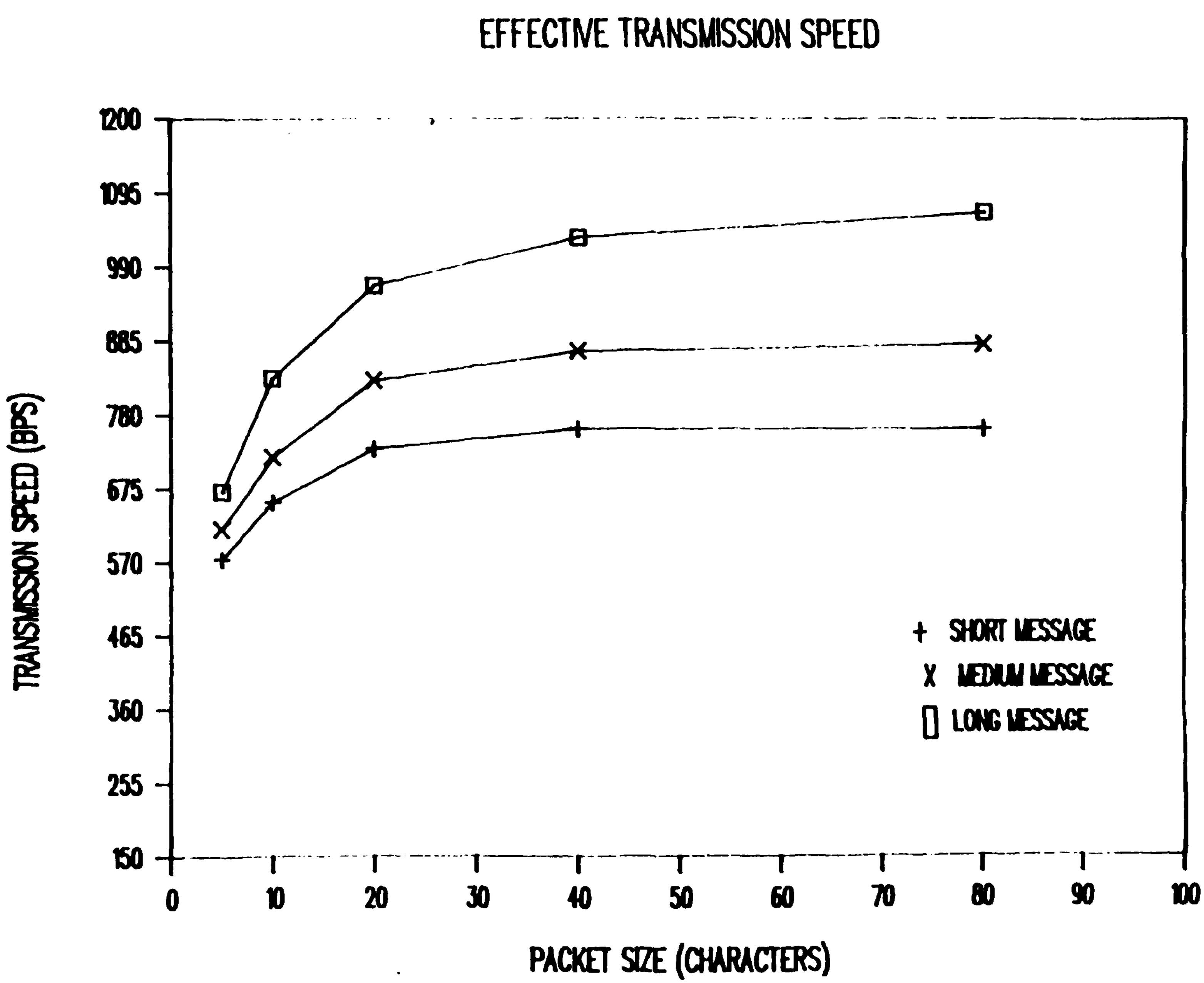


Figure B-32. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous

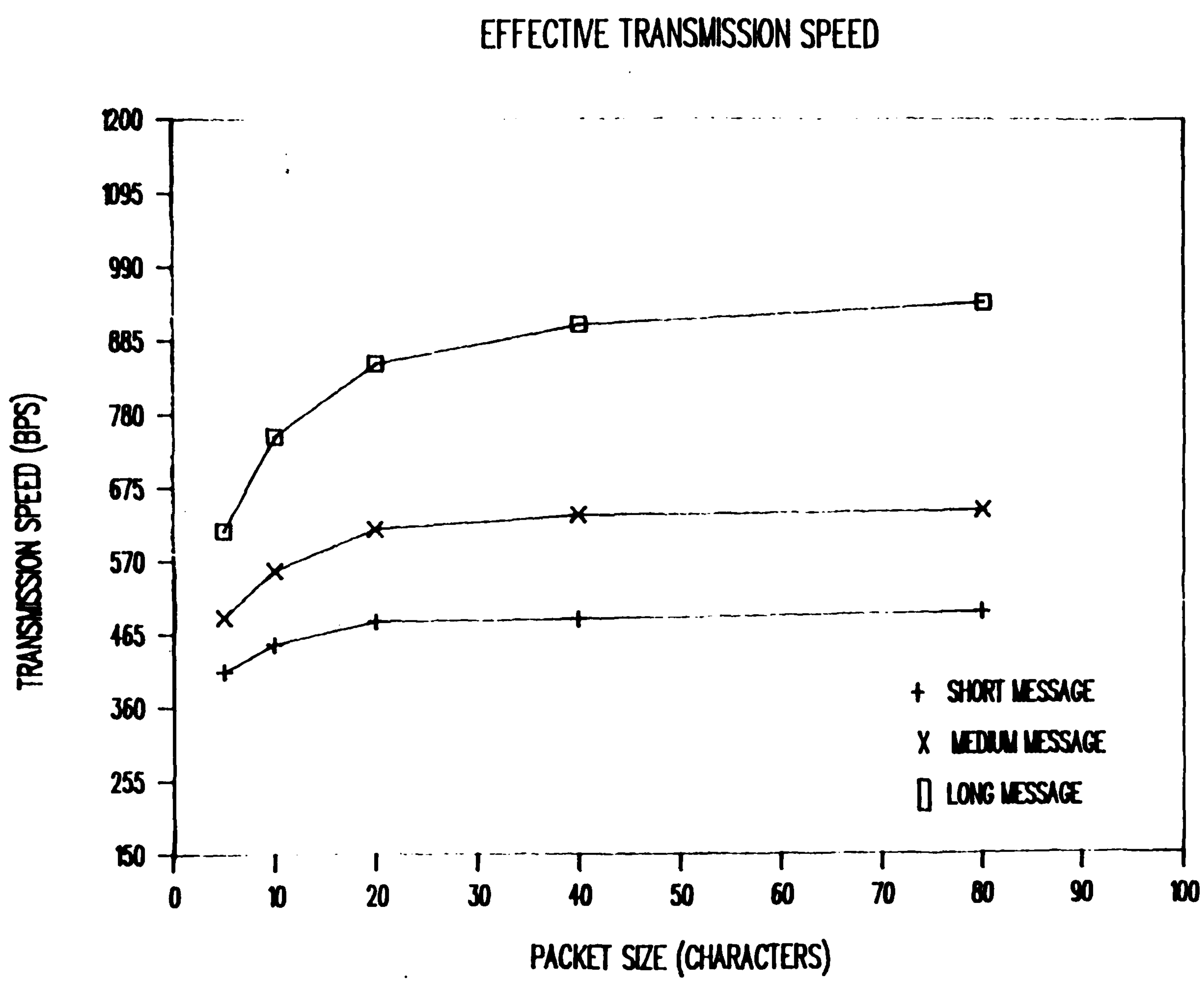


Figure B-33. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous

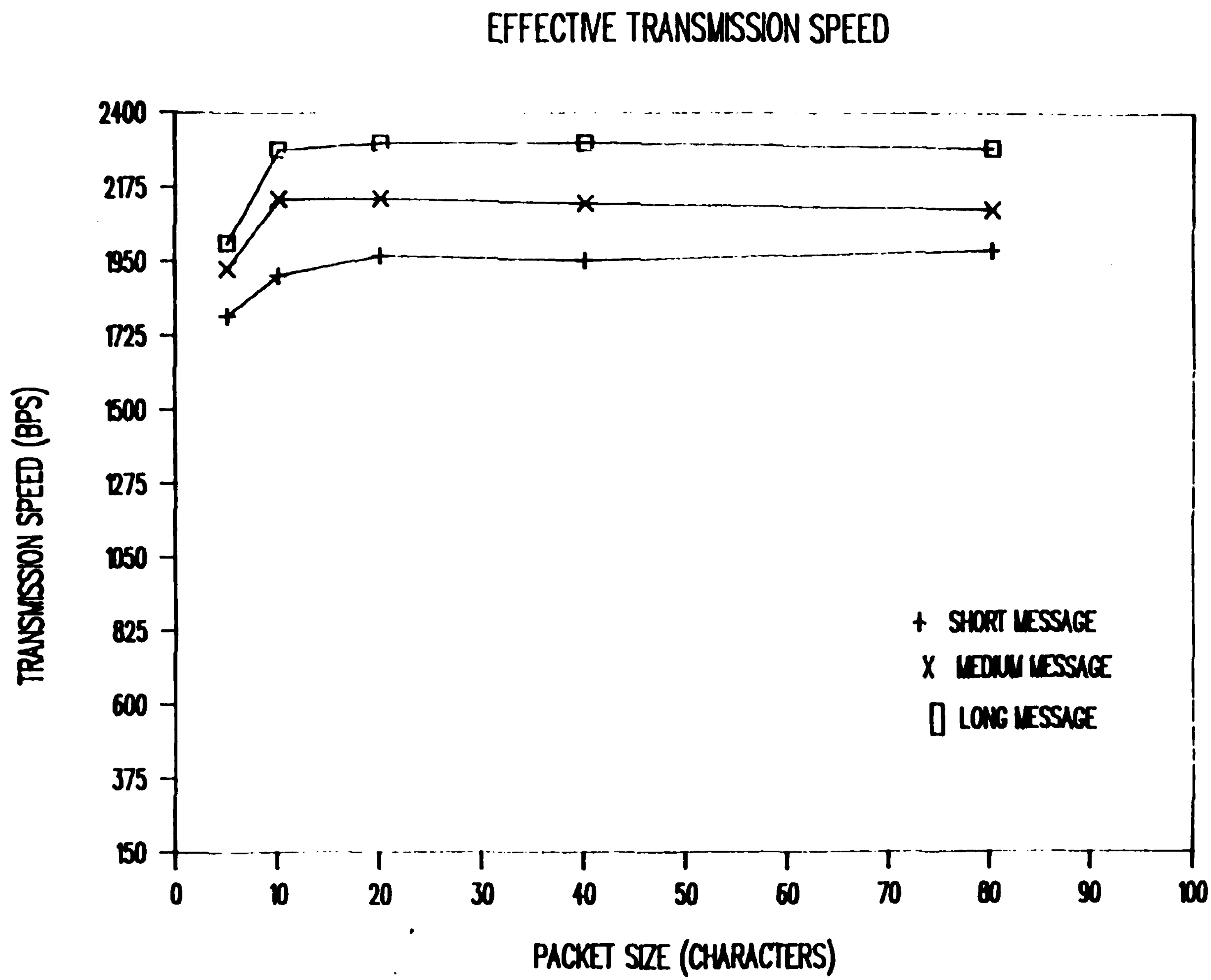


Figure B-34. MD-1061 Modem, 2400 b/s, 0 Second Interleaver Delay, Mode I Continuous

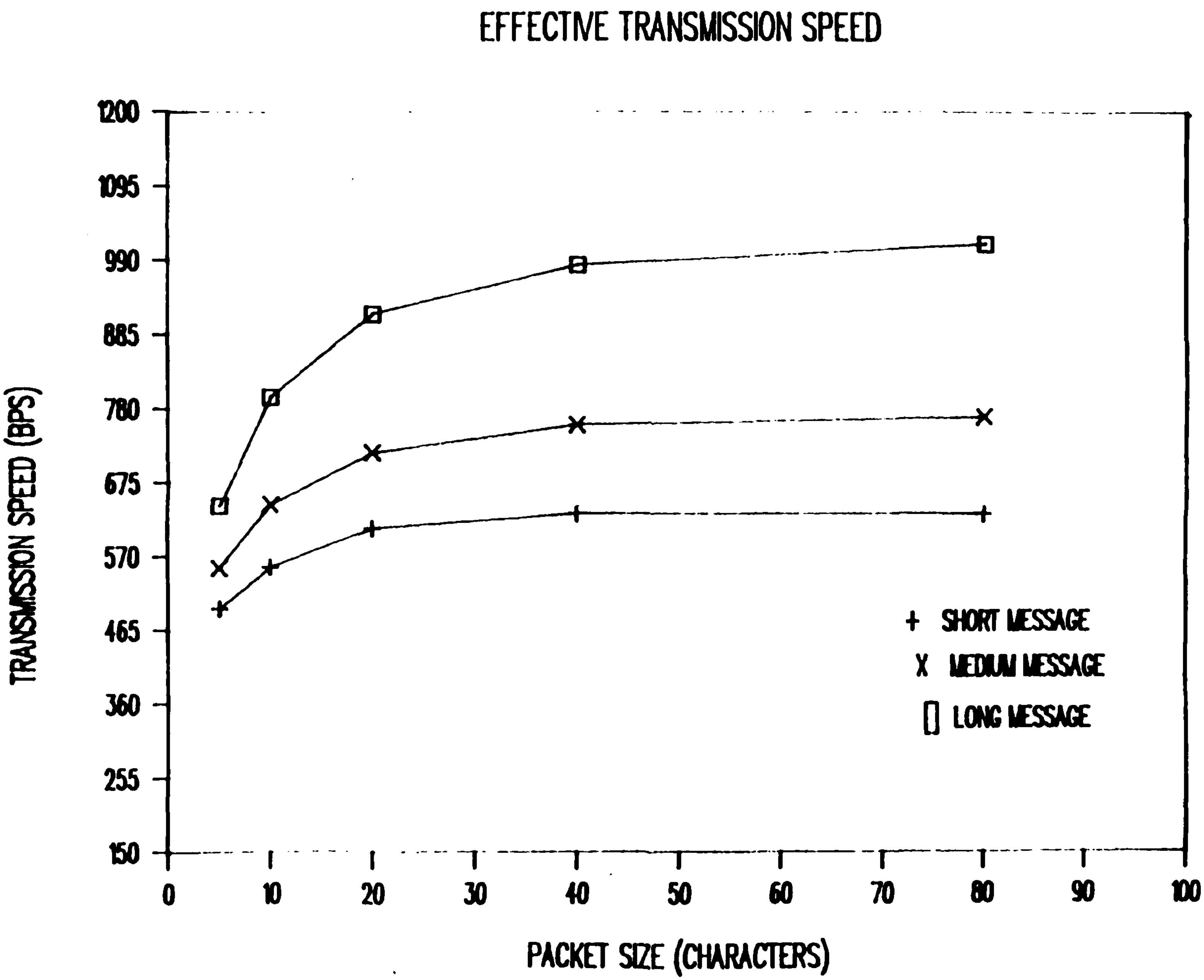


Figure B-35. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous

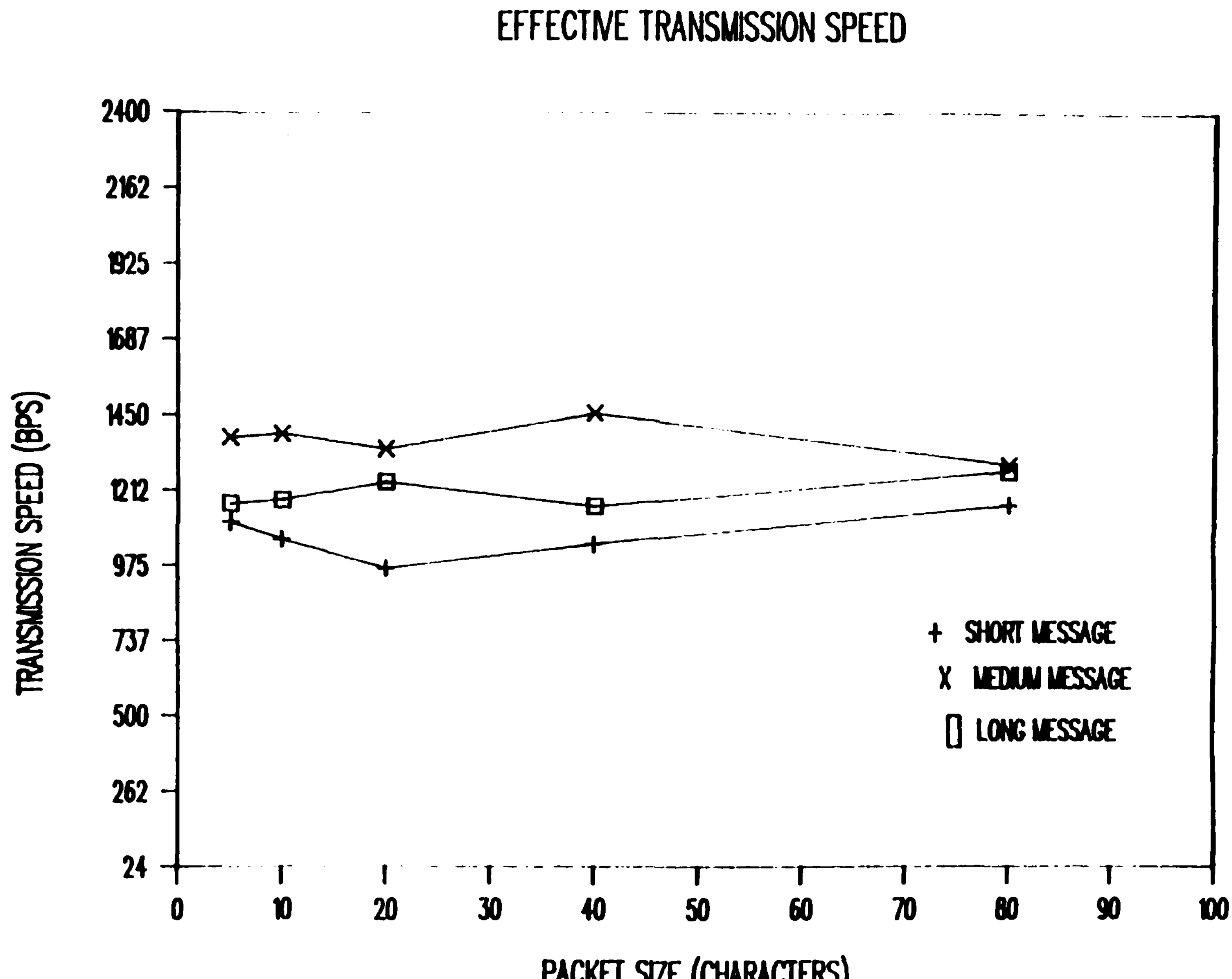


Figure B-36. MD-1061 Modem, 2400 b/s, 0 Second Interleaver Delay, Mode I Continuous

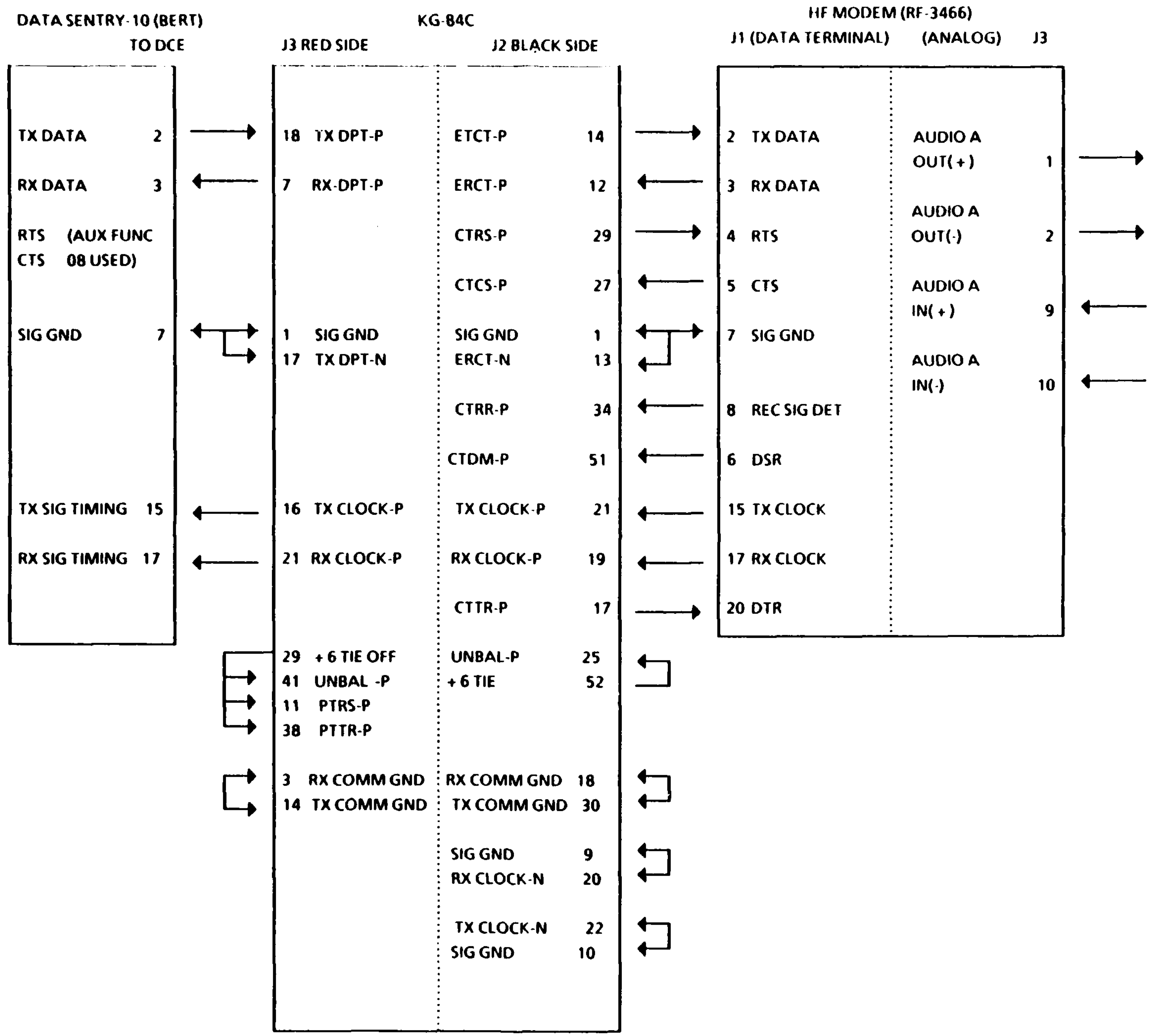


Figure B 37. Data Sentry 10, TSEC/KG-84C and HF Modem (RF-3466) Interconnect Diagram, with Clock from HF Modem

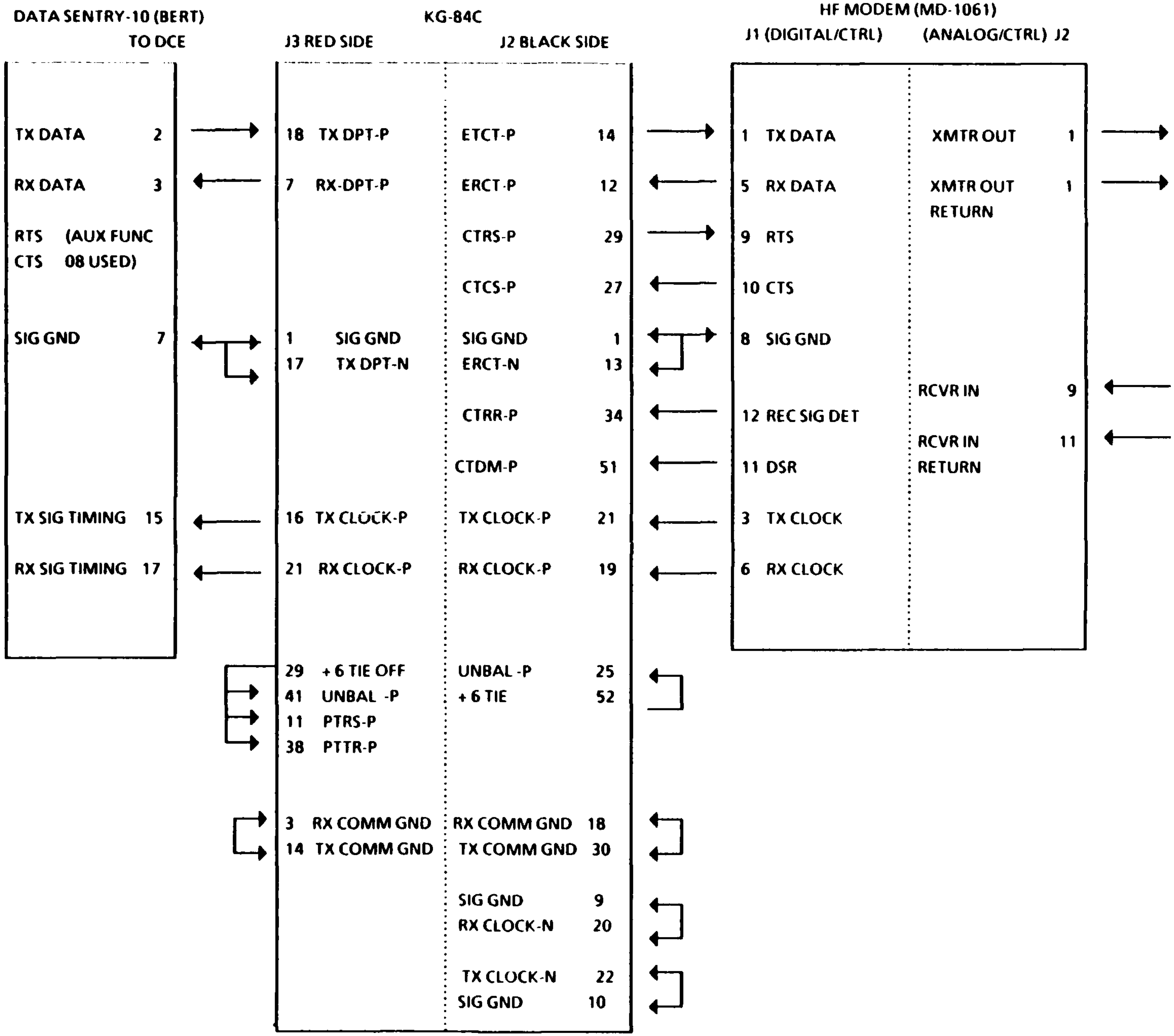


Figure B-38 Data Sentry 10, TSEC/KG 84C and HF Modem (MD 1061) Interconnect Diagram, with Clock from HF Modem

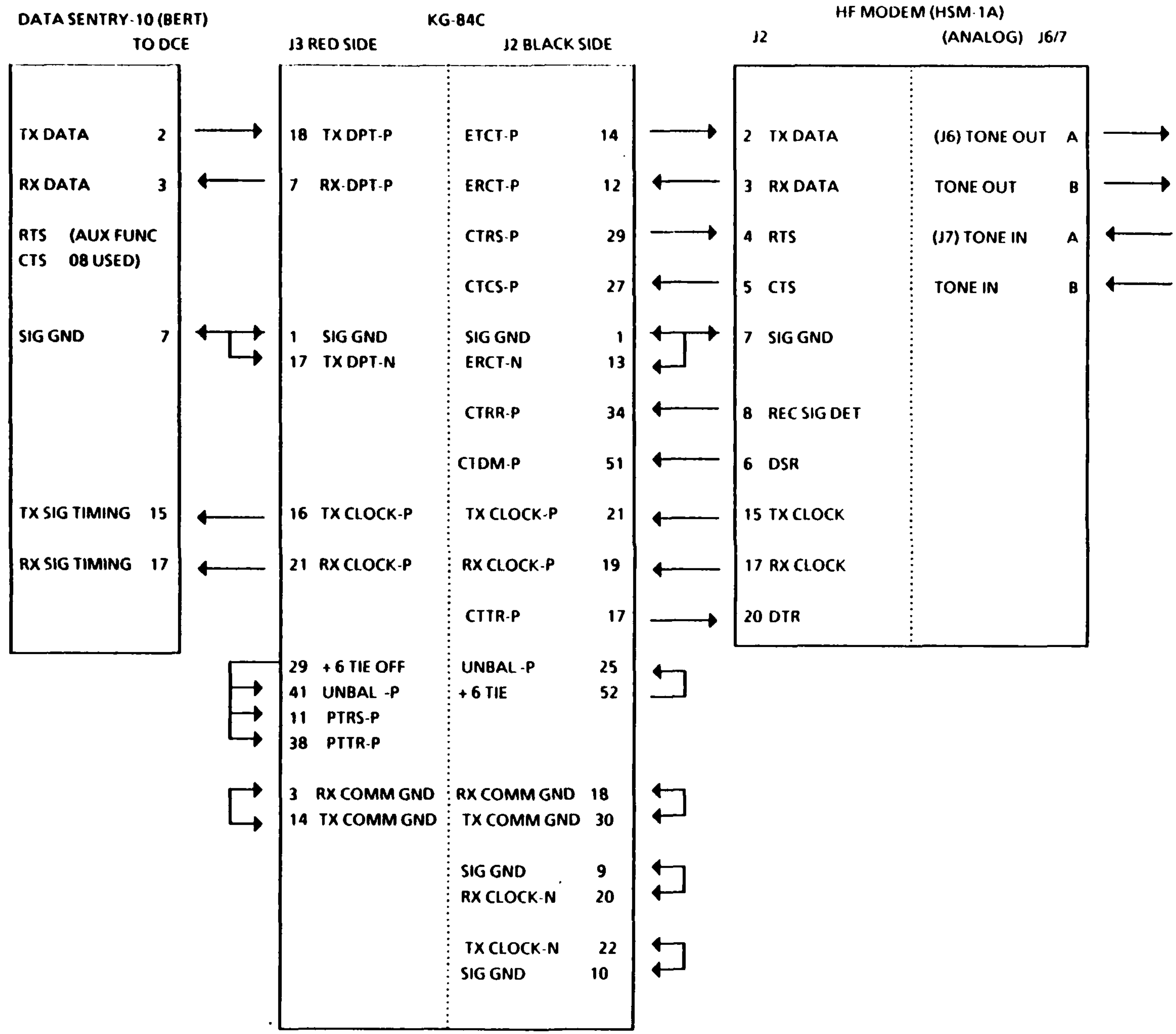


Figure B-39 Data Sentry 10, TSEC/KG-84C and HF Modem (HSM-1A) Interconnect Diagram, with Clock from HF Modem

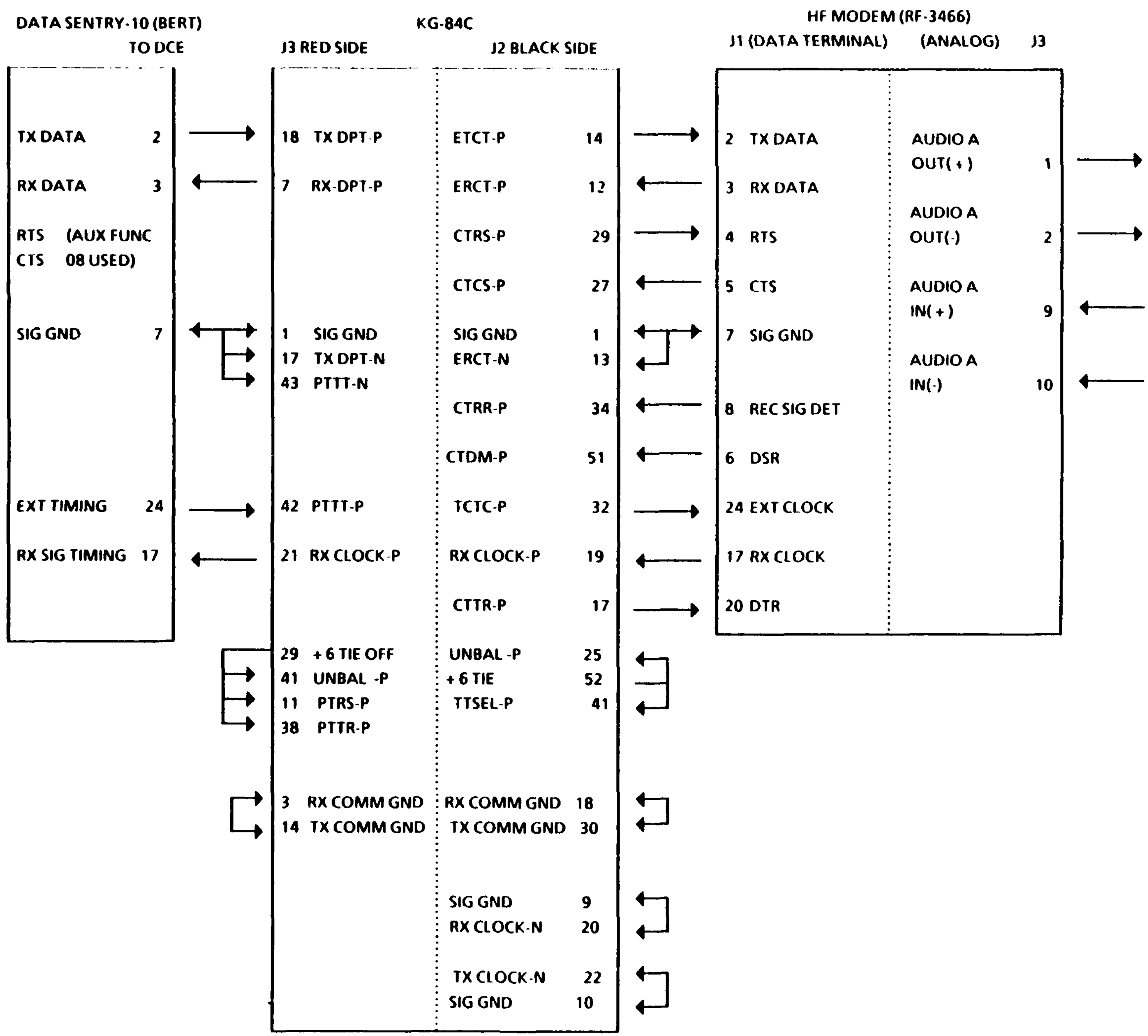


Figure B-40 Data Sentry 10, TSEC/KG-84C and HF Modem (RF-3466) Interconnect Diagram, with External Clock to HF Modem

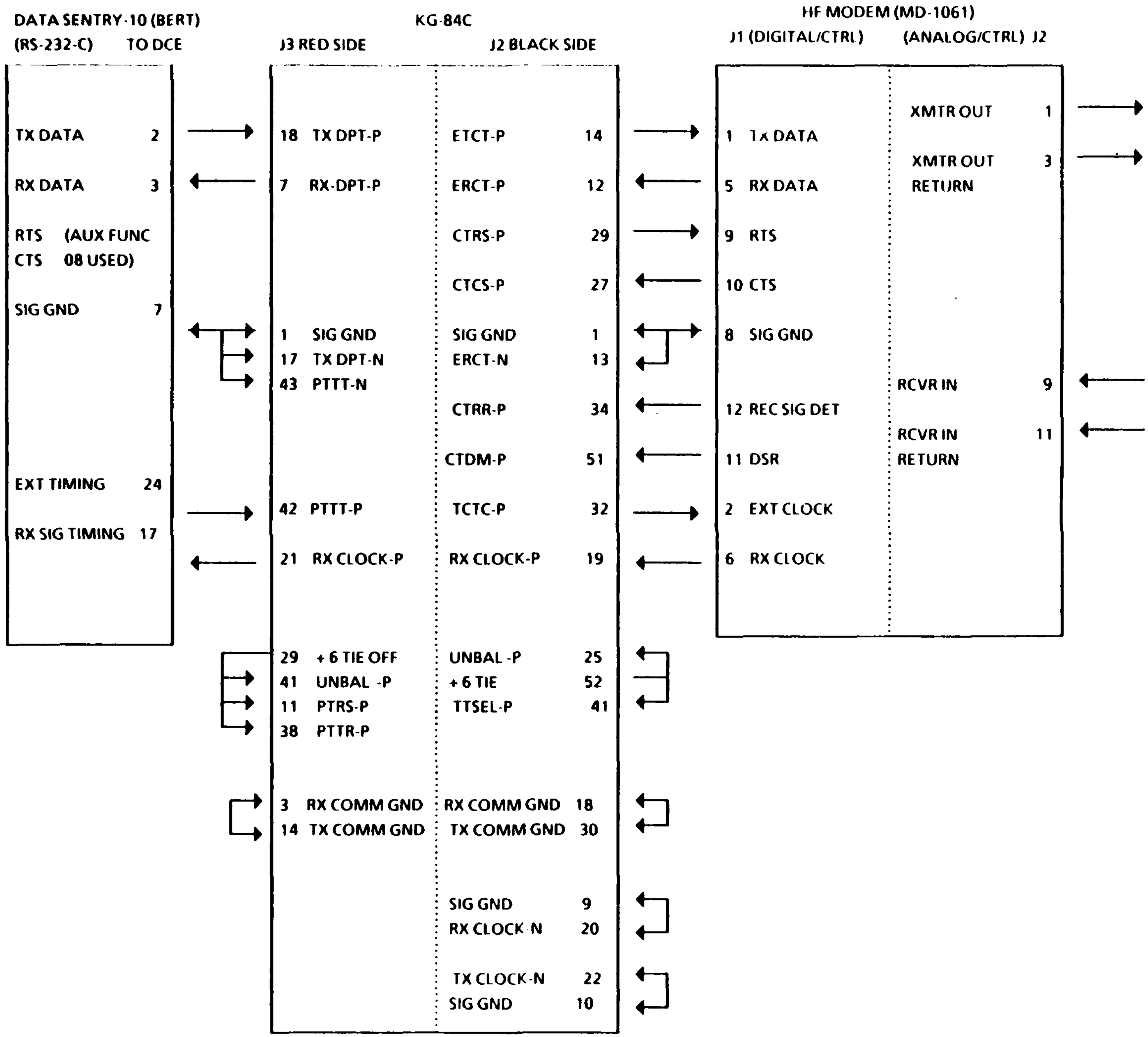


Figure B-41 Data Sentry 10, TSEC/KG-84C and HF Modem (MD-1061) Interconnect Diagram, with External Clock to HF Modem

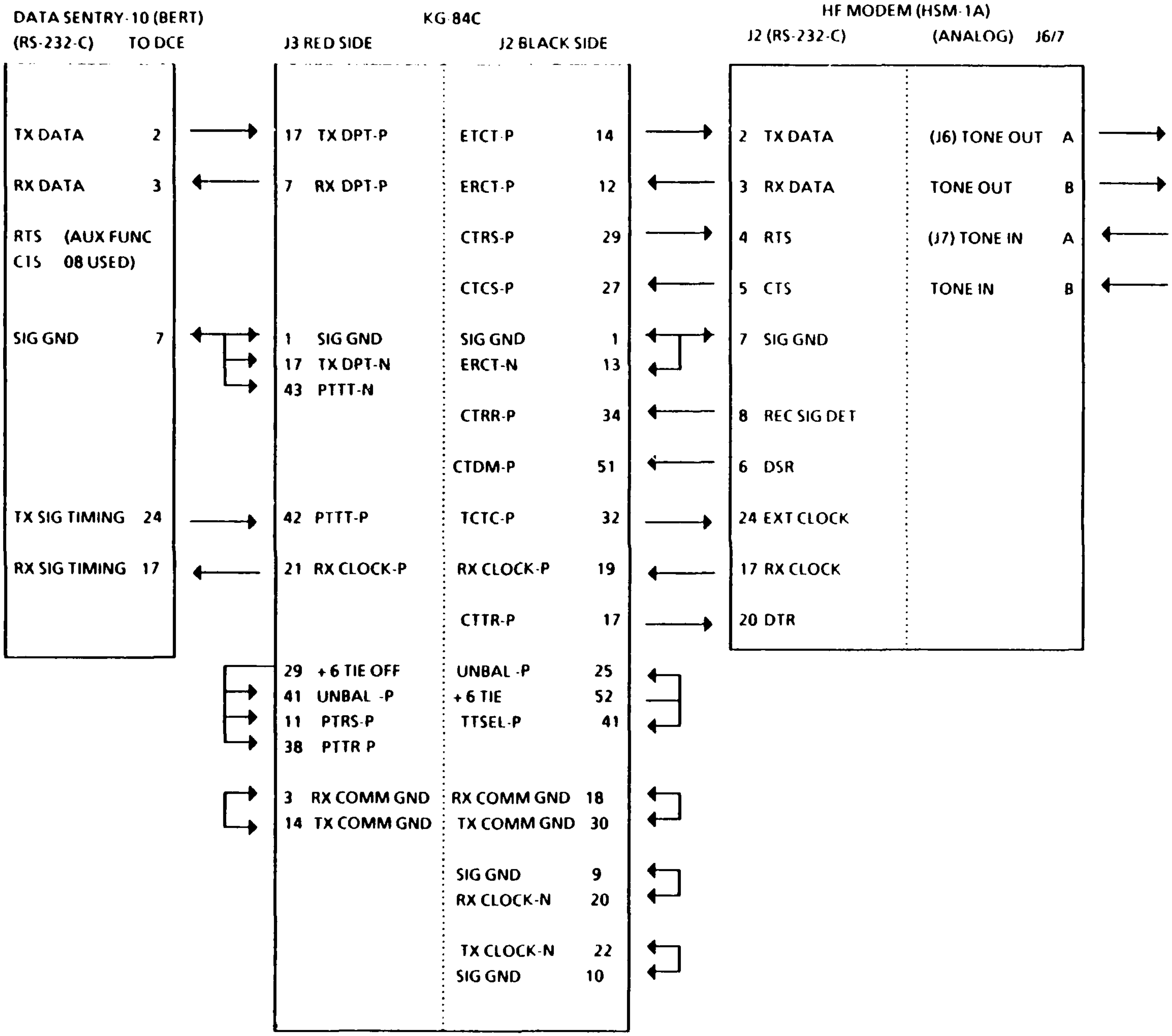


Figure B-42. Data Sentry 10, TSEC/KG-84C and HF Modem (HSM-1A) Interconnect Diagram, with External Clock to HF Modem

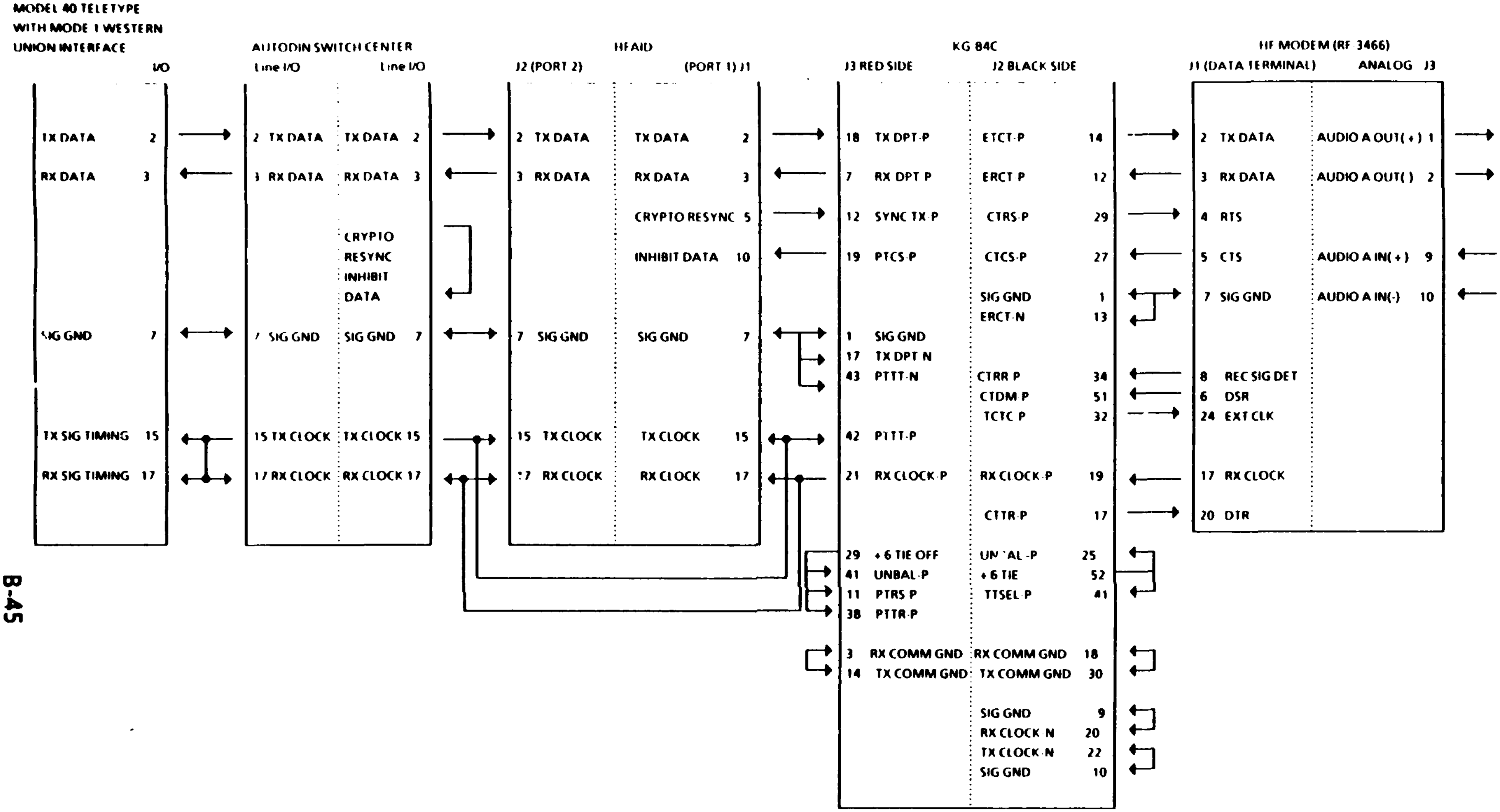
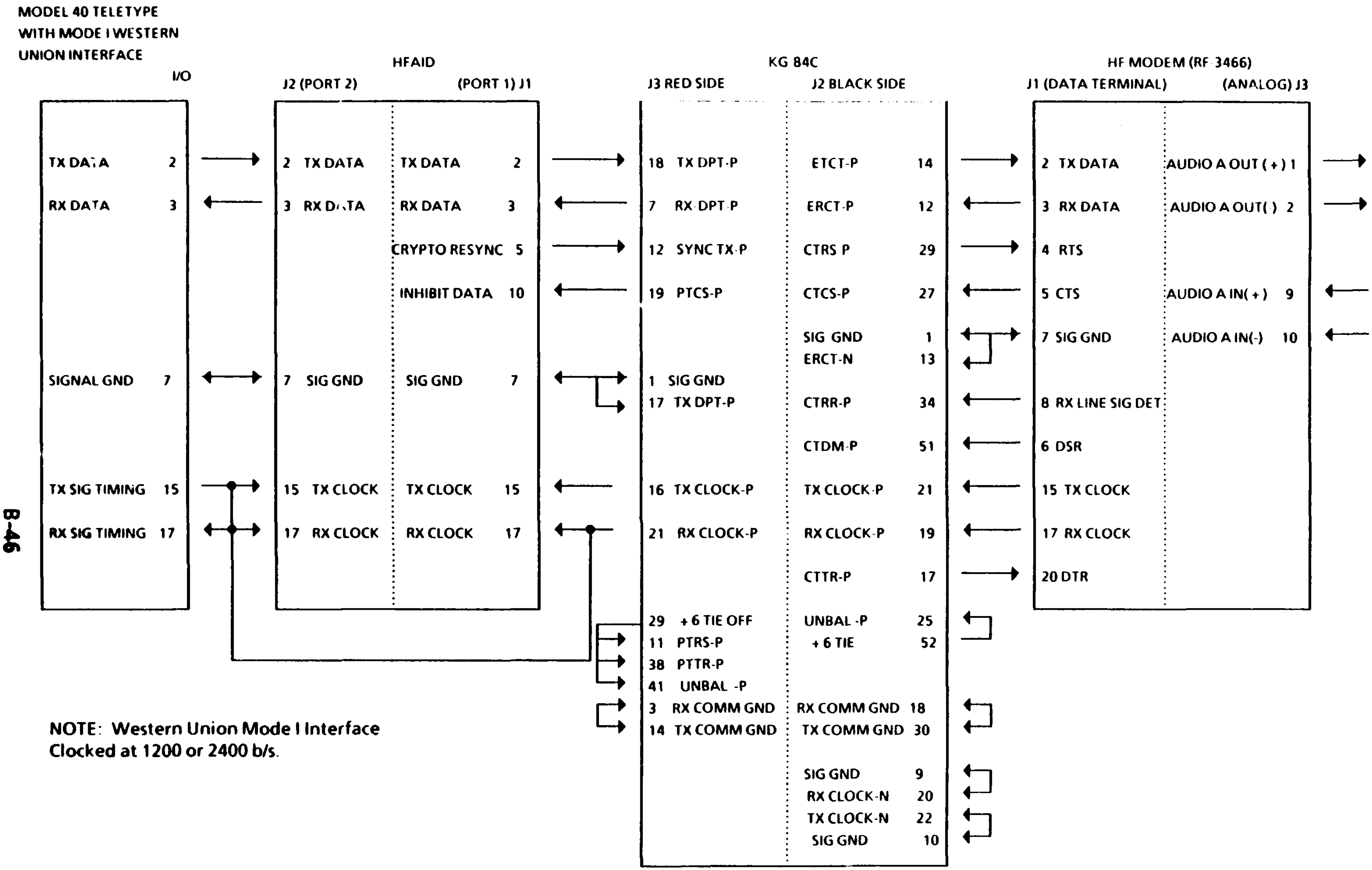


Figure B-43. Mode 1 Teletype (Model 40), ASC, HFAID, TSEC/KG-84C and HF Modem (RF-3466) Interconnect Diagram, using the ASC Timing (Phase I & II)



NOTE: Western Union Mode I Interface
Clocked at 1200 or 2400 b/s.

Figure B-44. Mode I Teletype Terminal (Model 40), HFAID, TSEC/KG-84C and HF Modem (RF-3466) Interconnect Diagram (Phase I & II)

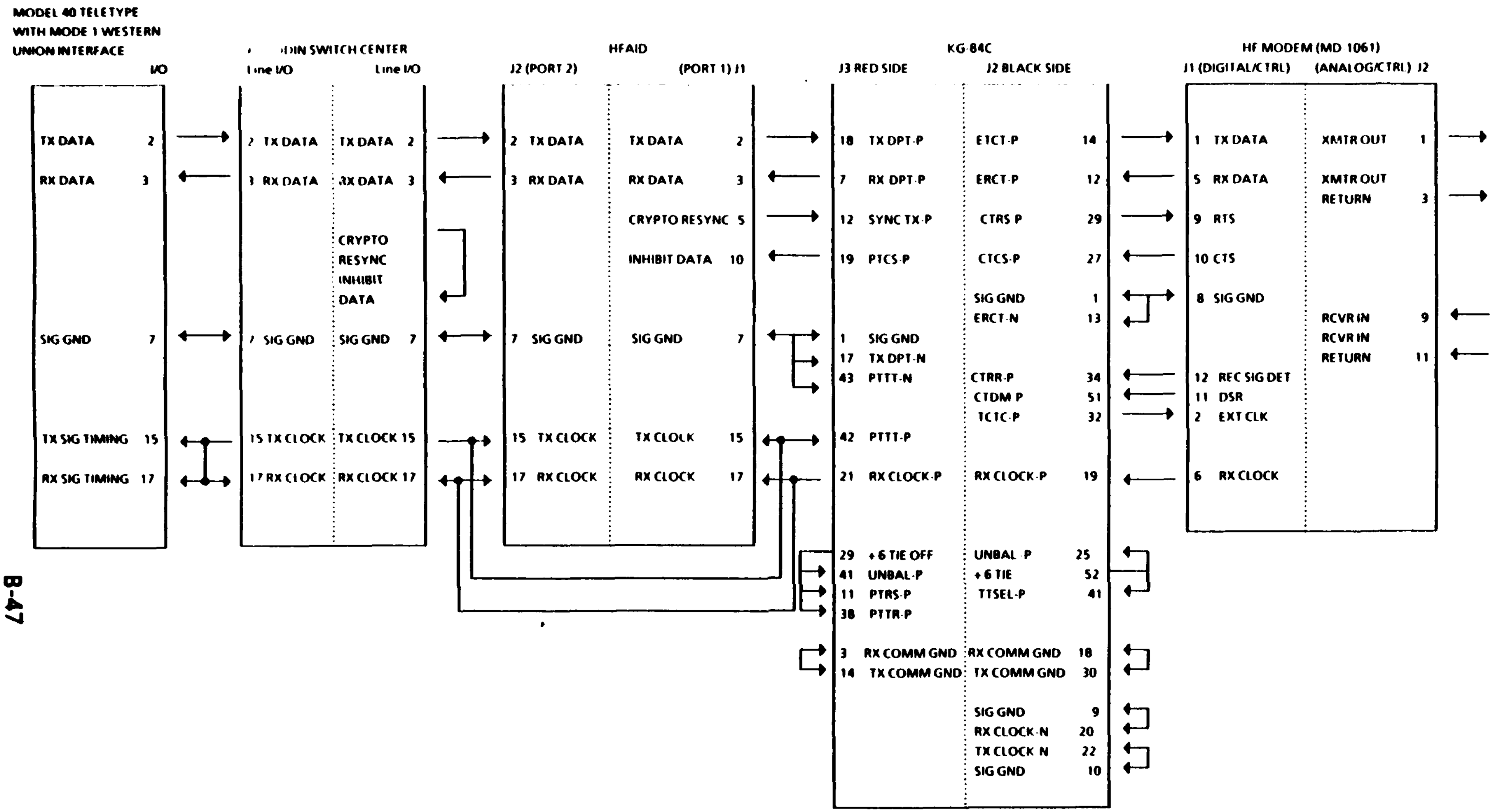
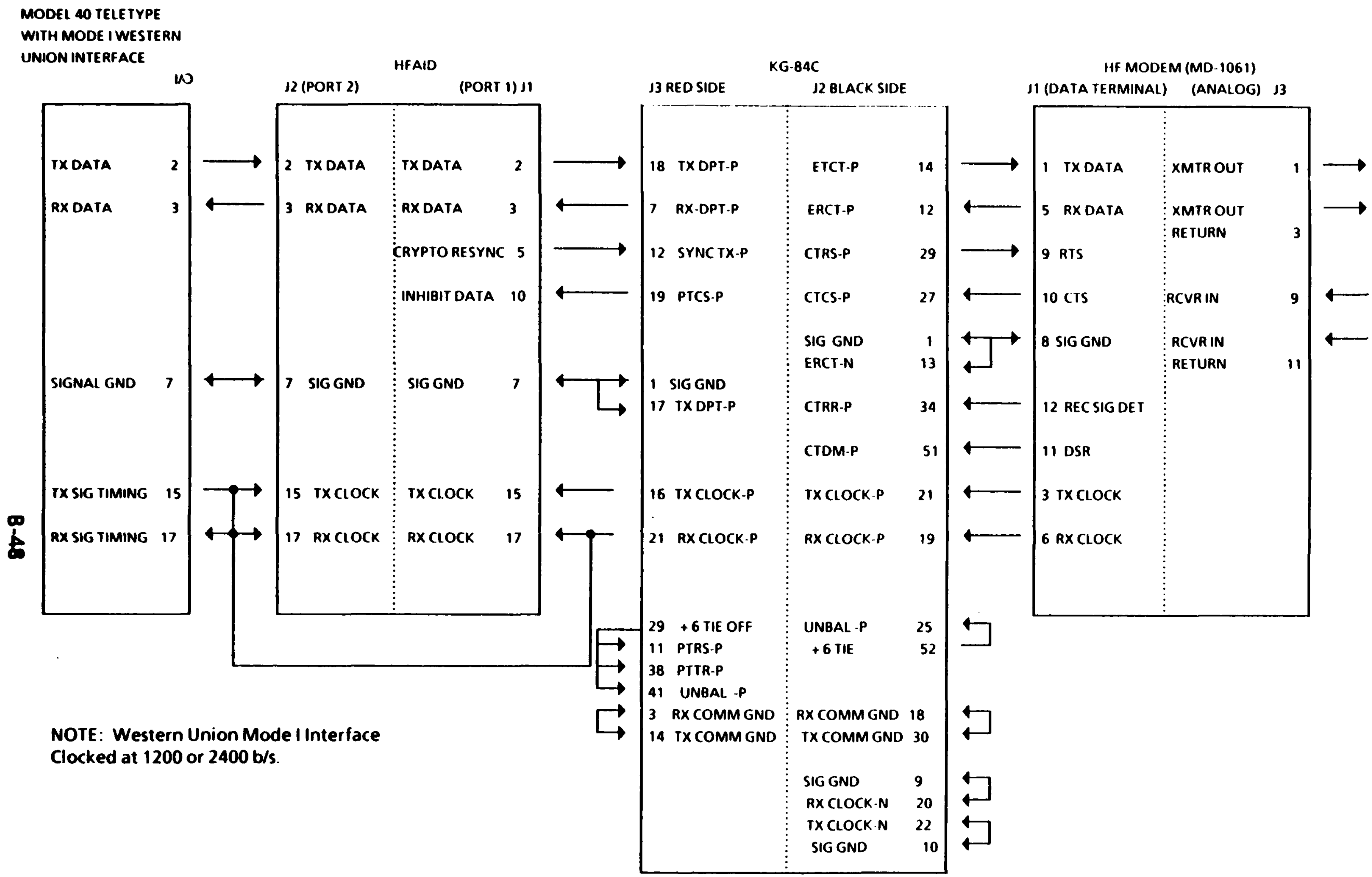


Figure B 45. Mode 1 Teletype (Model 40), ASC, HFAID, TSEC/KG-84C and HF Modem (MD-1061) Interconnect Diagram, using the ASC Timing (Phase I & II)



NOTE: Western Union Mode I Interface
Clocked at 1200 or 2400 b/s.

Figure B-46. Mode I Teletype Terminal (Model 40), HFAID, TSEC/KG-84C and HF Modem (MD-1061) Interconnect Diagram (Phase I & II)

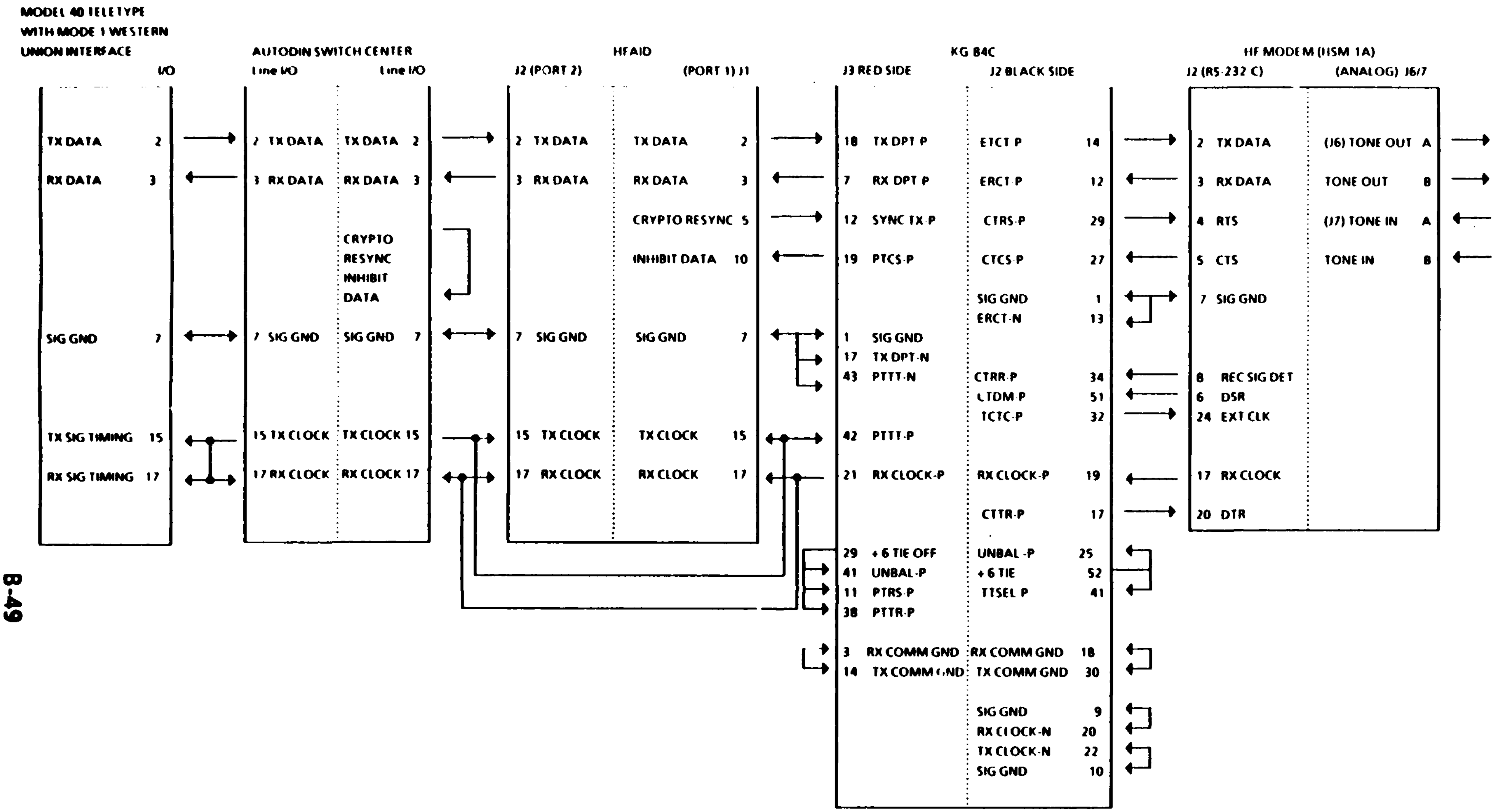
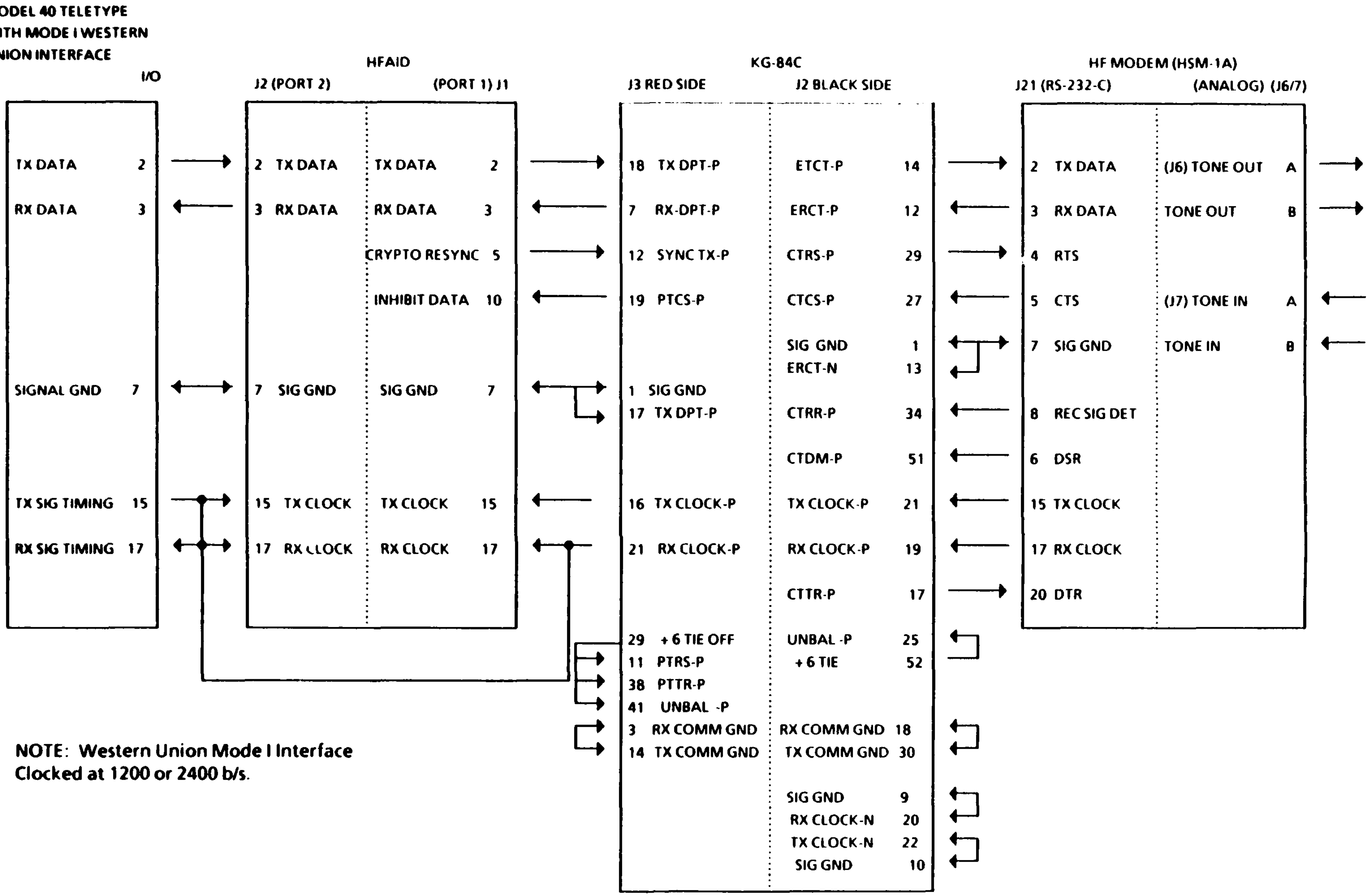


Figure B-47. Mode 1 Teletype (Model 40), ASC, HFAID, TSEC/KG-84C and HF Modem (HSM-1A) Interconnect Diagram, using the ASC Timing (Phase I & II)



NOTE: Western Union Mode I Interface
Clocked at 1200 or 2400 b/s.

Figure B-48. Mode I Teletype Terminal (Model 40), HFAID, TSEC/KG-84C and HF Modem (HSM-1A) Interconnect Diagram (Phase I & II)

Message Exchanged Between Model 40/Mode I (Western Union) Terminal and the HFAID Mode I Input

SITE: Fort Detrick, MD
DATA RATE: 1200 b/s (Mode I)
4800 b/s (Model 40)

```
Tx                                FULL DUPLEX
Rx    ZSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
       YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    44SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
        YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSHRATUZYUW
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYH
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx     RUQQWZA0000 0000000-UUUU--RUQQSDA.CCLZNR UUUUUCCLBTCCLEESSSSSSSSSSSSSSS
                                   RRF        RRF  RRFMB YYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSS7#PTC001$PTC001PTC001PTC001PTC001PTC001PTC001PTC001PTC001P
      YYYYYYYYYYYYYYXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    TC001PTC001PTC001PTC001EES7#PTC002$PTC002PTC002PTC002PTC002PTC002PTC002P
                                BMXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    TC002PTC002PTC002PTC002PTC002PTC002ESS7#PTC003$PTC003PTC003PTC003PTC003P
                                            BBXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    TC003PTC003P                                             $PTC004PTC004P
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY      YYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    TC004PTC004PTC004PTC004PTC004PTC004PTC004PTC004PTC004PTC004EFS7#PTC005SP
                                                                        BSXF
```

Figure B-49. Phase I & II, Mode I Test Message, 1200 b/s

```
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC003PTC005PTC005PTC005PTC005PTC005PTC005PTC005PTC005PTC005PTC005PTC005E
                                                                                B
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    GS7#PTC006$PTC006PTC006PTC006PTC006PTC006PTC006PTC006PTC006PTC006PTC006P
      SXF
Tx    SSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC006PTC006ERS7#PTC007SPTC007PTC007PTC007PTC007PTC007PTC007PTC007PTC007P
                 BSXF
Tx    SSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC007PTC007PTC007PTC007EUS7#PTC008SPTC008PTC008PTC008PTC008PTC008PTC008
                            BSXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC008PTC008PTC008PTC008PTC008PTC008EDS7#PTC009$PTC009PTC009PTC009PTC009P
                                        B1XF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC009PTC009PTC009PTC009PTC009PTC009PTC009PTC009EDS7#PTC010$PTC010PTC010P
                                                    B1XF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC010PTC010PTC010PTC010PTC010PTC010PTC010PTC010PTC010PTC010EES7#PTC011$P
                                                              BMXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYY
      -----------------------------------------------------------------
Rx    TC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011E
                                                                                B
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    CS7#PTC012SPTC012PTC012PTC012PTC012PTC012PTC012PTC012PTC012PTC012PTC012P
      NXF
Tx    SSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC012PTC012EES7#PTC013SPTC013PTC013PTC013PTC013PTC013PTC013PTC013PTC013P
                 BCXF
Tx    SSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC013PTC013PTC013PTC013ESS7#PTC014SPTC014PTC014PTC014PTC014PTC014PTC014P
                            BBXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------
Rx    TC014PTC014PTC014PTC014PTC014PTC014EGS7#PTC015SPTC015PTC015PTC015PTC015P
                                        BSXF
Tx    SSSSSSSS                                                SSSSSSSSSS
      YYYYYYYY                                                YYYYYYYYYY
```

Figure B-49. Phase I & II, Mode I Test Message, 1200 b/s (continued)


```
      -----------------------------------------------------------------
Rx    TC015PTC015PTC015PTC015PTC015PTC015PTC015PTC015EPS7#PTC016SPTC016PTC016P
                                                    BSXF
      SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSS
```

```
Rx    TC027P.C027PTC027PTC02.P.C02.P.C0.. .... .... -
                                                            BSXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    TC028PTC028PTC028PTC028PTC028PTC028PTC028PTC028PTC028PTC028DDS7CCL*0000C
                                                             D2XFRRF      R
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYY
      ------------------------------------------------------------------------
Rx    CLNNNDDDFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      R:      YY YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSS                                                   SSSSSSSSSSS
      YYYYYY                                                       YYYYYYYYYYY
```

Figure B-49. Phase I & II, Mode I Test Message, 1200 b/s (continued)

```
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS*****SSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY          YYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
```

```
Rx   TC016PTC016PTC016PTC016PTC016PTC016PTC016PTC016PTC016PTC016EUS7#PTC017$P
                                                                BSXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYY
     ------------------------------------------------------------------------
Rx   TC017PTC017PTC017PTC017PTC017PTC017PTC017PTC017PTC017PTC017PTC017PTC017E
                                                                           B
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   RS7#PTC018$PTC018PTC018PTC018PTC018PTC018PTC018PTC018PTC018PTC018PTC018P
     SXF
Tx   SSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC018PTC018EDS7#PTC019$PTC019PTC019PTC019PTC019PTC019PTC019PTC019PTC019P
               BDXF
Tx   SSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC019PTC019PTC019PTC019EDS7#PTC020$PTC020PTC020PTC020PTC020PTC020PTC020P
                           BLXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC020PTC020PTC020PTC020PTC020PTC020EES7#PTC021$PTC021PTC021PTC021PTC021P
                                       BBXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC021PTC021PTC021PTC021PTC021PTC021PTC021PTC021EES7#PTC022$PTC022PTC022P
                                                   BCXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC022PTC022PTC022PTC022PTC022PTC022PTC022PTC022PTC022PTC022ECS7#PTC023$P
                                                                BNXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYY
     ------------------------------------------------------------------------
Rx   TC023PTC023PTC023PTC023PTC023PTC023PTC023PTC023PTC023PTC023PTC023PTC023E
                                                                           B
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   ES7#PTC024$PTC024PTC024PTC024PTC024PTC024PTC024PTC024PTC024PTC024PTC024P
     MXF
Tx   SSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC024PTC024ERS7#PTC025$PTC025PTC025PTC025PTC025PTC025PTC025PTC025PTC025P
               BSXF
Tx   SSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC025PTC025PTC025PTC025EUS7#PTC026$PTC026PTC026PTC026PTC026PTC026PTC026P
                           BSXF
Tx   SSSSSSSS                                                     SSSSSSSSSSS
     YYYYYYYY                                                     YYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC026PTC026PTC026PTC026PTC026PTC      S7#PTC027$PTC027PTC027PTC027PTC027P
                                          XF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYY
```

Figure B-49. Phase I & II, Mode I Test Message, 1200 b/s (continued)

Message Exchanged Between Model 40/Mode I (Western Union) Terminal and the HFAID Mode I Input

SITE: Fort Detrick, MD
DATA RATE: 2400 b/s (Mode I)
4800 b/s (Model 40)

```
-------------------------------------------
Tx                                FULL DUPLEX
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSHRATUZYUW RUQQTXA0000 0000000-UUU
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYH
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    U--RUQQSDA.CCLZNR UUUUUCCLBTCCLEERSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                 RRF         RRF  RRFMB YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYY                                               YYYYYYYYYYYY
      ------------                                               ------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
```

Figure B-50. Phase I & II, Mode I Test Message, 2400 b/s

```
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  :PTC001PTC001PTC001PTC001PTC001PTC001PTC001PTC001EESSSSSSSSSSSSSSSSSSSSS
                                                     BMYYYYYYYYYYYYYYYYYYYYY
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  SSSSSSSSSSSSSSSSSSSSS7#PTC002$PTC002PTC002PTC002PTC002PTC002PTC002PTC002
    YYYYYYYYYYYYYYYYYYYYYXF
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  PTC002PTC002PTC002PTC002PTC002ESSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                  BBYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  S7#PTC003$PTC003PTC003PTC003PTC003PTC003PTC003PTC003PTC003PTC003PTC003PT
    XF
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  C003PTC003EESSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC004$PTC004PTC
              BCYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx  SSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  004PTC004PTC004PTC004PTC004PTC004PTC004PTC004PTC004PTC004PTC004EFSSSSSSS
                                                                   BSYYYYYYY
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYY
    ------------------------------------------------------------------------
Rx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC005$PTC005PTC005PTC005PTC005PTC00
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  5PTC005PTC005PTC005PTC005PTC005PTC005PTC005EGSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                               BSYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  SSSSSSSSSSSSSSS7#PTC006$PTC006PTC006PTC006PTC006PTC006PTC006PTC006PTC006
    YYYYYYYYYYYYYYYXF
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  PTC006PTC006PTC006PTC006ERSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PT
                            BSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  C007$PTC007PTC007PTC007PTC007PTC007PTC007PTC007PTC007PTC007PTC007PTC007P
Tx  SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
    -----------                                                  -----------
Rx  TC007EUSSSS                                                      :008PTC
         BSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx  SSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
    YYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYY           YYYYYYYYYYYYYYYYYYYYYYYYY
    ------------------------------------------------------------------------
Rx  008PTC008PTC008PTC008PTC008PTC008PTC008PTC008PTC008PTC008EDSSSSSSSSSSSSS
                                                           BLYYYYYYYYYYYYY
```

Figure B-50. Phase I & II, Mode I Test Message, 2400 b/s (continued)

```
-------------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC009$PTC009PTC009PTC009PTC009PTC009PTC0
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   09PTC009PTC009PTC009PTC009PTC009PTC009EDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                           B1YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   SSSSSSSS7#PTC010$PTC010PTC010PTC010PTC010PTC010PTC010PTC010PTC010PTC010
     YYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   PTC010PTC010PTC010EESSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC011$P
                       BMYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   TC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011PTC011E
                                                                            B
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   CSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC012$PTC012PTC012PTC012PTC
     BYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   012PTC012PTC012PTC012PTC012PTC012PTC012PTC012PTC012EESSSSSSSSSSSSSSSSSSSS
                                                       BCYYYYYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSSS7#PTC013$PTC013PTC013PTC013PTC013PTC013PTC013PTC0
     YYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   13PTC013PTC013PTC013PTC013PTC013ESSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                    BBYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   SSSS7#PTC014$PTC014PTC014PTC014PTC014PTC014PTC014PTC014PTC014PTC014PTC01
     YYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   4PTC014PTC014EGSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC015$PTC015P
                  BSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
-------------------------------------------------------------------------
Rx   TC015PTC015PTC015PTC015PTC015PTC015PTC015PTC015PTC015PTC015PTC015EFSSSSS
                                                                     BSYYYYY
Tx   SSSSSSSSSSS                                                     SSSSSFF
     YYYYYYYYYYY                                                     YYYYYSS
```

Figure B-50. Phase I & II, Mode I Test Message, 2400 b/s (continued)

```
-------------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS:      PTC016$PTC016PTC016PTC016PTC016PT
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
```

```
Rx   C016PTC016PTC016PTC016PTC016PTC016PTC016PTC016EUSSSSSSSSSSSSSSSSSSSSSSS
                                                    BSYYYYYYYYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYY
     --- --- ----------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSS7#PTC017SPTC017PTC017PTC017PTC017PTC017PTC017PTC017PTC
     YYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   17PTC017PTC017PTC017PTC017LRSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#
                               BSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   PTC018SPTC018PTC018PTC018PTC018PTC018PTC018PTC018PTC018PTC018PTC018PTC01
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   8PTC018EDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC019SPTC019PTC019P
           BIYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   TC019PTC019PTC019PTC019PTC019PTC019PTC019PTC019PTC019PTC019EDSSSSSSSSSSS
                                                              BLYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYY
     ------------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC020SPTC020PTC020PTC020PTC020PTC020PT
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   C020PTC020PTC020PTC020PTC020PTC020PTC020ESSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                             BBYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   SSSSSSSSSSSS7#PTC021SPTC021PTC021PTC021PTC021PTC021PTC021PTC021PTC021PTC
     YYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   021PTC021PTC021PTC021EESSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC022
                          BCYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   SPTC022PTC022PTC022PTC022PTC022PTC022PTC022PTC022PTC022PTC022PTC022PTC02
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   2ECSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC023SPTC023PTC023PTC023
      BNYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     ------------------   ---------------------------------------------------
Rx   PTC023PTC02                                                       SSSSSS
                                                                       YYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS      SSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYY
     ------------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC024SPTC024PTC024PTC024PTC024PTC024PTC024PT
```

Figure B-50. Phase I & II, Mode I Test Message, 2400 b/s (continued)

```
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    C024PTC024PTC024PTC024PTC024PTC024ERSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                        BSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSS7#PTC025$PTC025PTC025PTC025PTC025PTC025PTC025PTC025PTC025PTC025PTC
      YYYYYXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    025PTC025PTC025EUSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC026$PTCC
                     BSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx    SSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    26PTC026PTC026PTC026PTC026PTC026PTC026PTC026PTC026PTC026PTC026PTC026EFSS
                                                                          BSYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7#PTC027$PTC027PTC027PTC027PTCC
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx    SAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    27PTC027PTC027PTC027PTC027PTC027PTC027PTC027PTC027EGSSSSSSSSSSSSSSSSSSSS
                                                        BSYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS FFSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY SSYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSS7#PTC028$PTC028PTC028PTC028P  028PTC028PTC028PT
      YYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    C028PTC028PTC028PTC028PTC028PTC028EDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                        B2YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSS7CCL#0000CCLNNNEEFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYXFRRF    RRF    MX YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSS                                                        SSSSSSS
      YYYYYYYYY                                                        YYYYYYY
```

Figure B-50. Phase I & II, Mode I Test Message, 2400 b/s (continued)


```
      ------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYY
```

Table B-1. BERTs (Data Sentry 10) Switch Settings (Phase I & II)

(1) EXTERNAL SWITCH SETTINGS (EXTERNAL CLOCK TO HF MODEM)

Switch Function	Setting
Data Pattern	2047
Error Insert	OFF
Mode	FDX
Timing	Sync
Gen Clk*	Synth
Synth Freq	1200 and/or 2400
Code Level	N/A
Parity	N/A
Stop Bits	N/A
Display I	ERRS
BER INTVL (BITS)	10^6
Display II	RCVR FREQ (Hz)
Print Event	Test INTVL
RCVR FUNCTION	Analyze
Emulate	DTE

* For Clock from HF Modem, Gen Clk to INTF, Synth Freq N/A.

(2) INTERNAL STRAPPING OPTIONS/SWITCH SETTINGS: None.

(3) AUXILIARY FUNCTION 08: Set to "ON".

Table B-2. HSM-1A Switch Settings (Phase I & II)

(1) EXTERNAL SWITCH SETTINGS

Switch Function	Setting
Code Level	Synchronous
Baud Rate	1200 or 2400
Mode	Norm

(2) INTERNAL STRAPPING OPTIONS/SWITCH SETTINGS: None.

(3) INTERLEAVER/DEINTERLEAVER: Factory set to 3.5 sec for 1200 and 2400 b/s.

Table B-3. RF-3466 Switch Settings (Phase I & II)

(1) EXTERNAL SWITCH SETTINGS:

Switch Function	Setting
Mode Select (75-2400 b/s)	1200 and/or 2400

(2) NTERNAL STRAPPING OPTIONS/SWITCH SETTINGS:

Switch Function (Digital I/O PWB Assembly)	Setting
S3-1, Data Mode	Sync
S3-2, Full/Half Duplex	Full Duplex
S6-7, 8 Channel Diversity	A
S6-2, Doppler Tracking	Enable
S6-3, Clipping	Enable
S3-5, Interleaving Factor	Normal = closed; Alternate = open.
S3-6, Interleaving Factor	Long = open Short = closed.

Data Rate	MODE (End-to End)
1200	Normal Long (12.6 sec)
1200	Alternate Short (1.71 sec)
2400	Alternate Short (1.58 sec)
2400	Normal Long (9.8 sec)

Switch Function	Setting
S4-2, Halt on Fault	Enable
S4-4, Send Test Message	Disable
S4-3, Loopback	Disable
S3-7, 8 Keyline Delay	45 msec
S1, RS-232-C/MIL-STD-188C	RS-232-C
S2, Frequency Select	INT (Internal Clock) for Clock from Modem or DTE (External CLock) for ASC Clock to Modem

Table B-4. MD-1061 Switch Settings (Phase I & II)

(1) EXTERNAL SWITCH SETTINGS:

Switch Function	Setting
Transmitter Key	Remote
Transmitter Output	Data
Transmitter Data Source	EXT
Transmitter Coding Mode	Coded
Transmtter Data Rate	1200 or 2400
Receiver Coding Mode	Coded
Receiver Data Rate	1200 or 2400
Receiver Diversity	A
Receiver Frequency Connection	On
Receiver Sync	Fast and Slow
Operate Mode	Normal

(2) INTERNAL STRAPPING OPTIONS AND SWITCH SETTINGS:

Function	Strap
Preamble Length in Frames	5 (E1 to E2) A2 Card
Degree of Interleaving (TX)	Switch ON A27 Card:
Degree of De-Interleaving (RX)	Switch ON A28 Card:

Data Rate	Delay	Switch Position Closed
1200	1.6	5
1200	6.4	7
2400	0	None

Table B-5. TSEC/KG-84C Switch Setting (Phase I & II)

(1) EXTERNAL CLOCK TO HF MODEM:

Switch Function	Setting
Clock	MA (Master)
Data Rate (TX)	INT 1200 or 2400
Data Rate (RX)	EXT
Data Length	Synchronous
TDM	OFF
Sync Mode	6 (HF)
Comm Mode	1 (Duplex)
TTY Mode Switch	1 (Auto Resync)
Sync Switch	OFF
Gated RXC	CRXC
Gated TXC	CTXC

(2) EXTERNAL CLOCK FROM HF MODEM:

Clock	MA (Master)
Data Rate (TX/RX)	EXT
Data Length	Synchronous
TDM	OFF
Sync Mode	6 (HF)
Comm Mode	1 (Duplex)
TTY Mode Switch	1 (Auto Resync)
Sync Switch	OFF
Gated RXC	CRXC
Gated TXC	CTXC

(3) INTERNAL STRAPPING OPTIONS/SWITCH SETTINGS:

Strap	Setting
PTRS (Char Pass)	Out (E2-E3) (For simplex HF mode only)
Time (Sec)	15 (E8-E4) (For simplex HF mode only)
IDLS	Out (E11-E12) (For simplex HF mode only)
KEK (VU)	Out (E13-E14) (For simplex HF mode only)
DATA MODE	Out (Baseband)

Table B-6. HFAID Switch Settings (Phase I & II)

(1) EXTERNAL SWITCH SETTINGS: None.

(2) INTERNAL STRAPPING OPTIONS/SWITCH SETTINGS:

Switch Function	Setting	Results
DIP Switch Bank 2		
Number of characters per HF Aid Block (Packet:	S6 S7 S8	
	0 0 0	80 Character Block
	0 0 1	40 Character Block
	0 1 0	20 Character Block
	0 1 1	10 Character Block
	1 0 0	5 Character Block
	1 0 1	5 Character Block
	1 1 0	5 Character Block
	1 1 1	5 Character Block
Crypto Polarity	S1 = 1 (Negative)	
Dip Switch Bank 3		
No Reply Counter Settings:	S7 S8	
	1 1	255 Transmissions before CAN
Block Ignore Counter Settings Before Crypto Resync: (80 Character Block)	S1 S2	
	1 1	Ignore 384 blocks
Strapping		
Internal/External Clock Selection	Line 1 - External (Ft. Detrick) Line 2 - External (Ft. Detrick)	
MARK Sense Selection	Line 1 - Positive MARK Line 2 - Positive MARK	

Section II - Phase II, HF Channel Simulator Testing

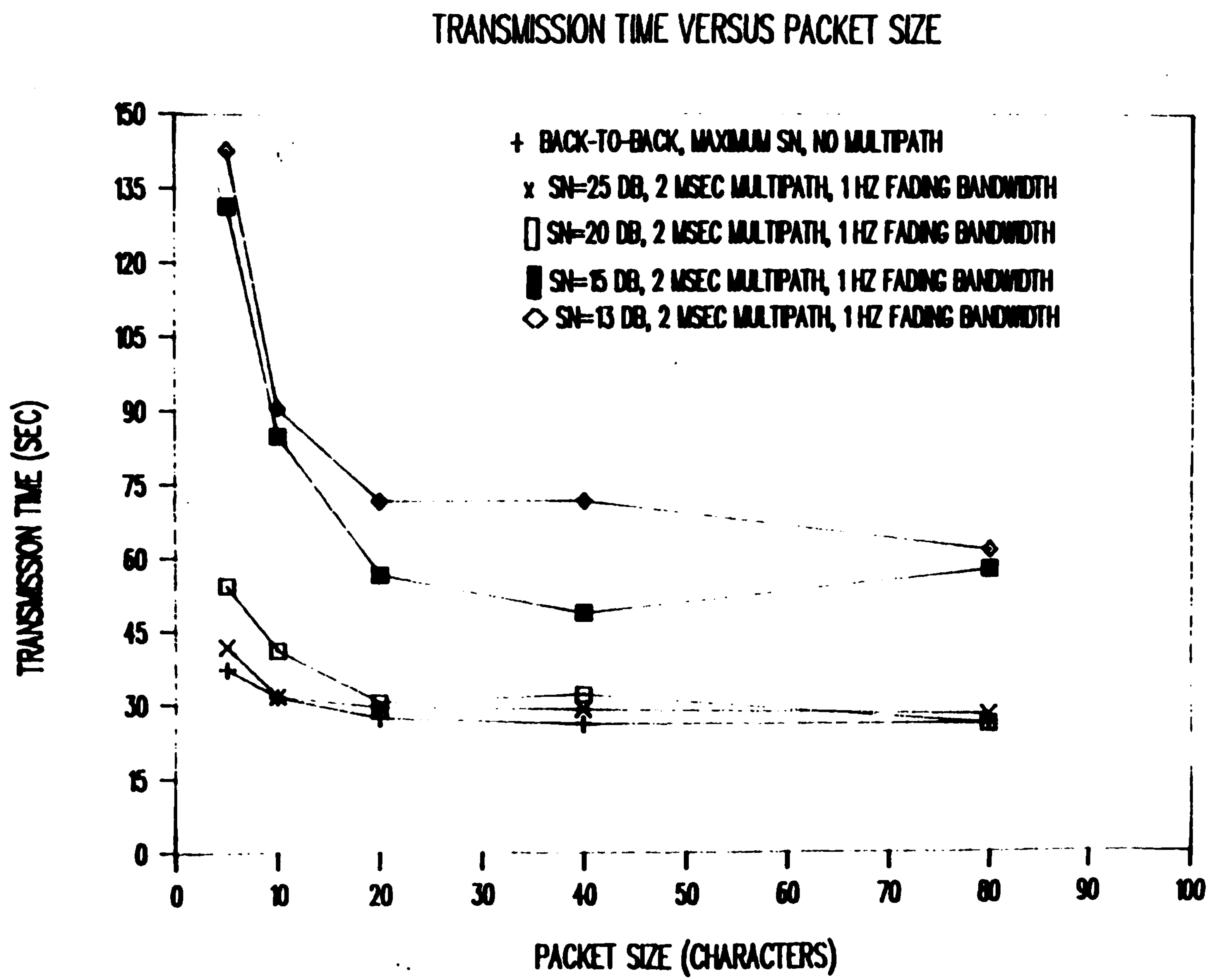


Figure B-51. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message

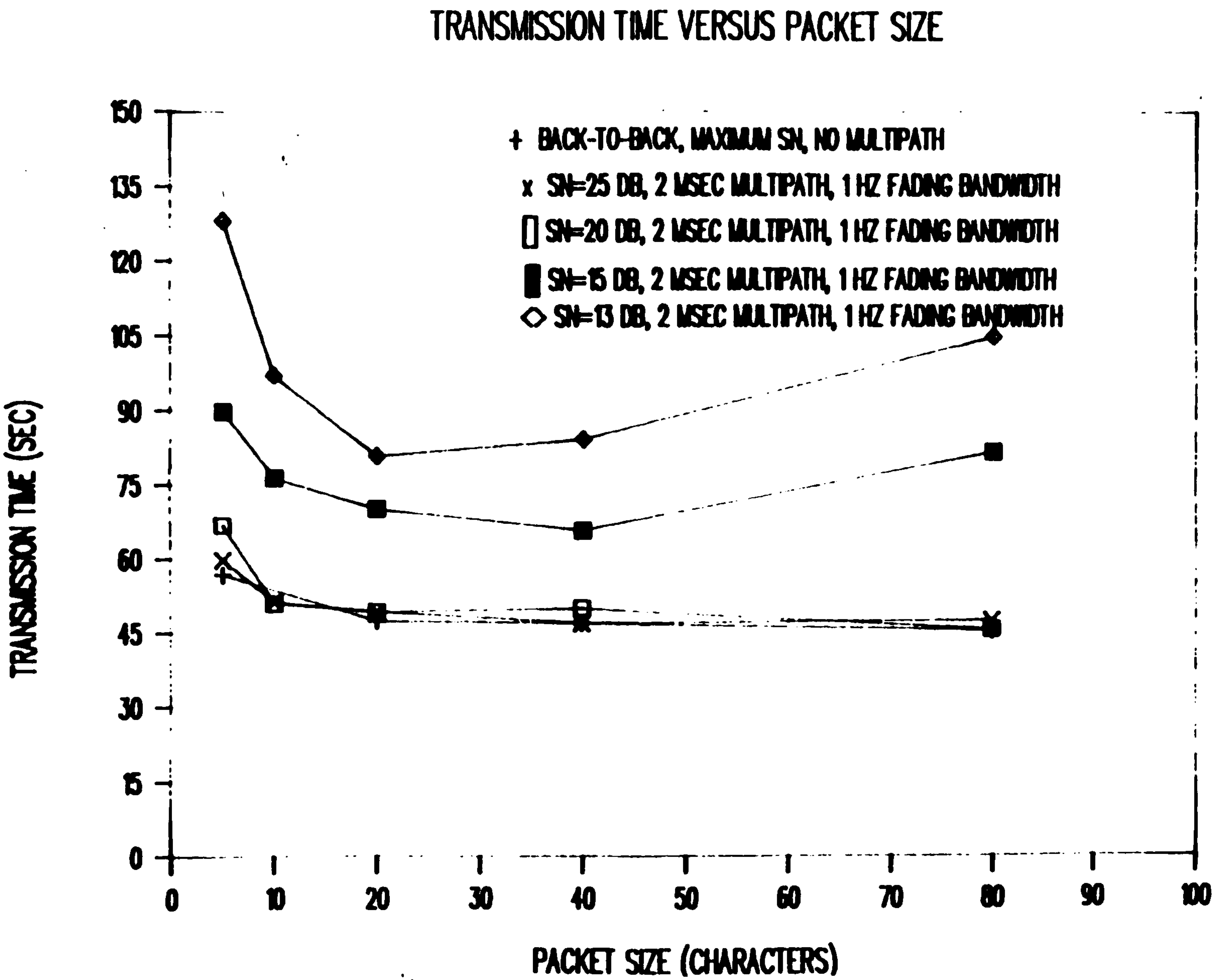


Figure B-52. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message

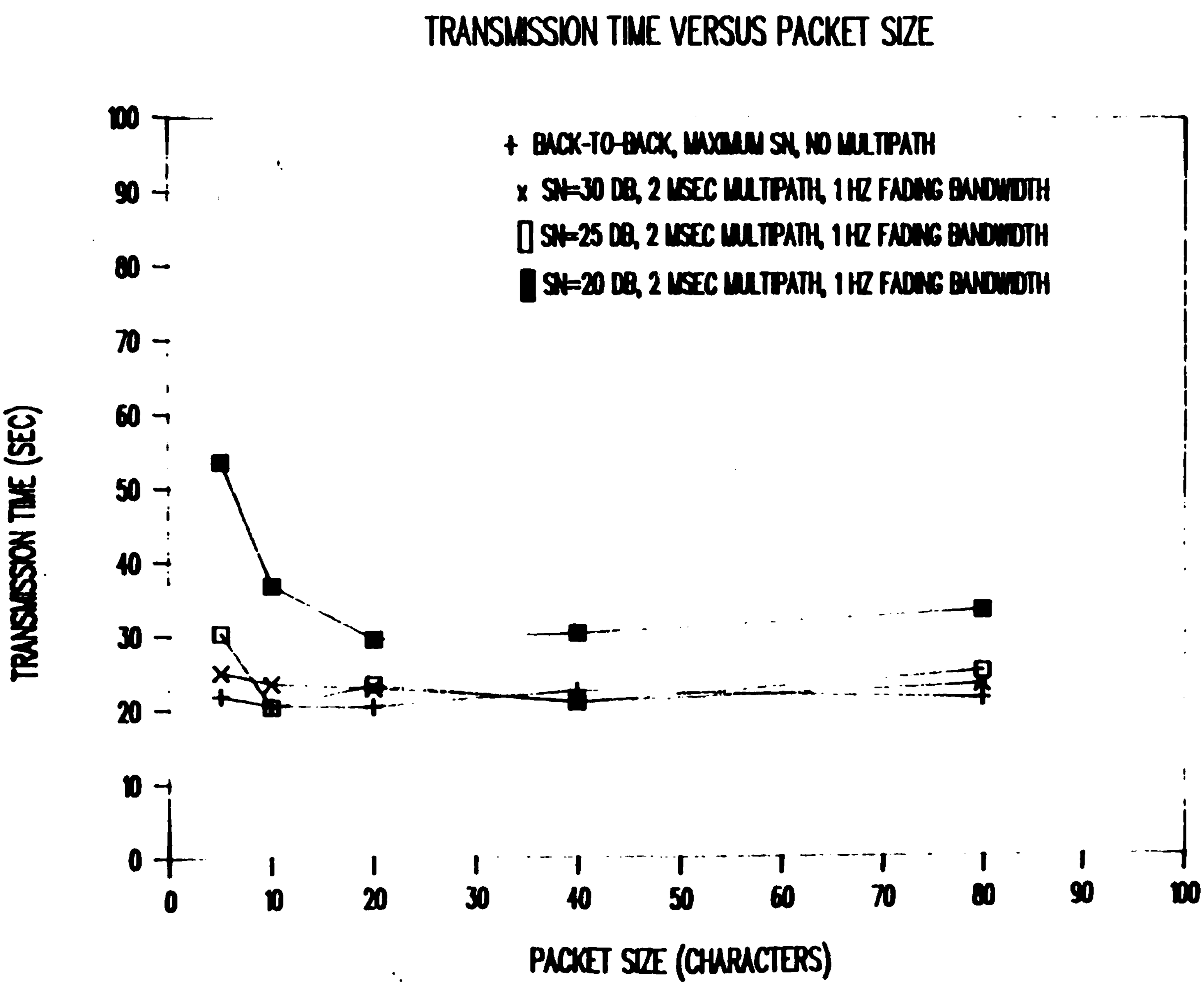


Figure B-53. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message

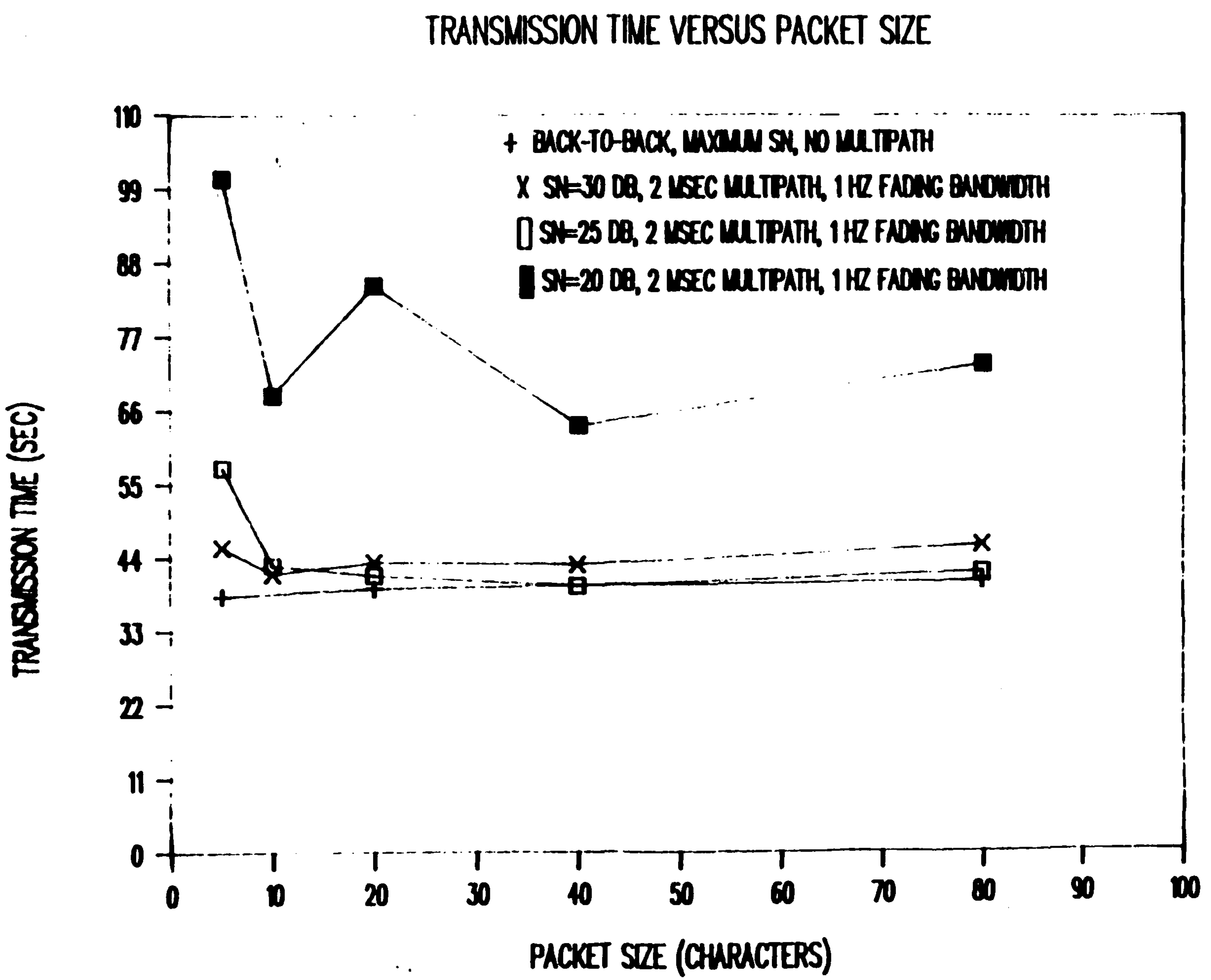


Figure B-54. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous, Medium Message

TRANSMISSION TIME VERSUS PACKET SIZE

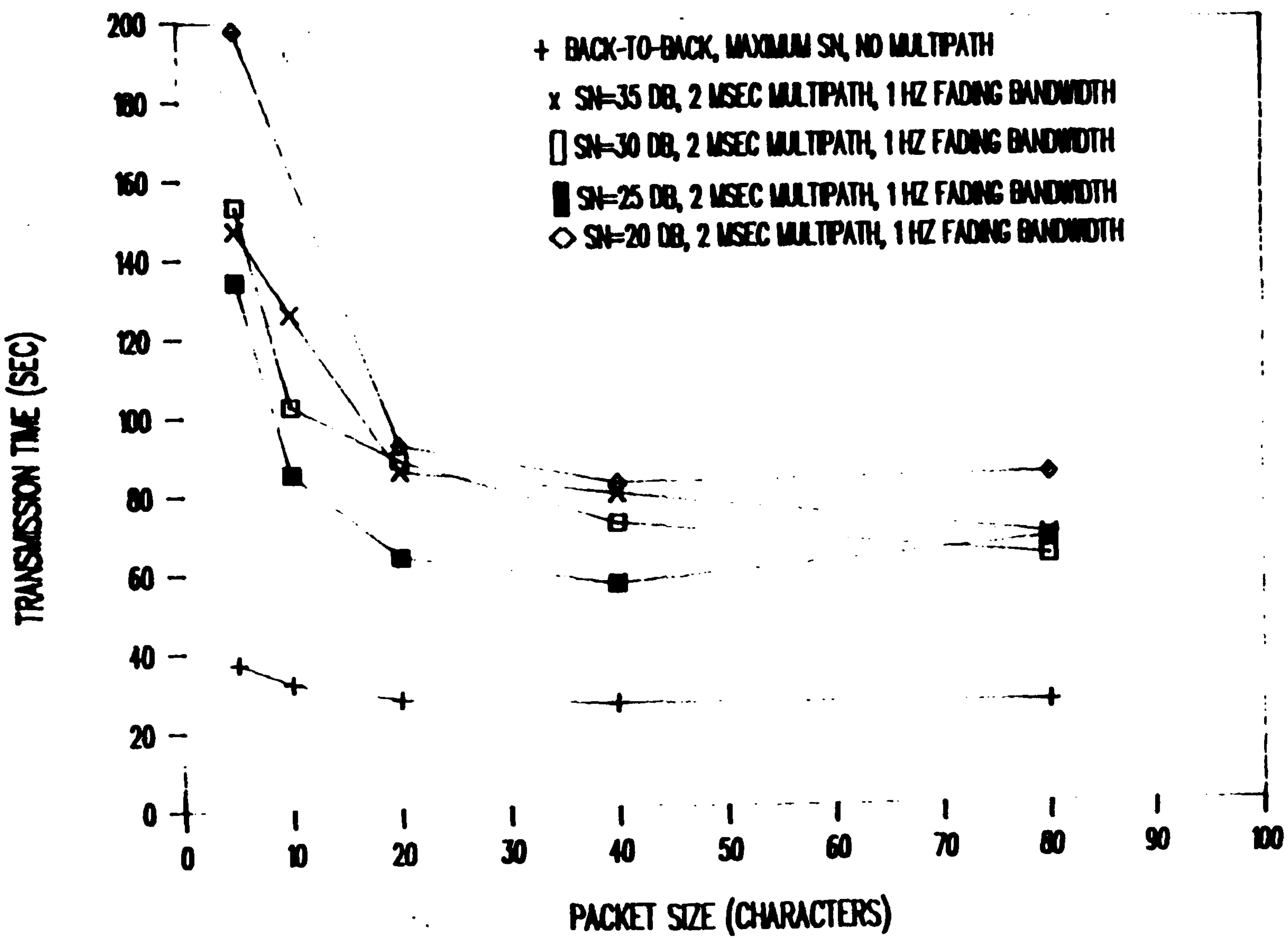


Figure B-55. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message

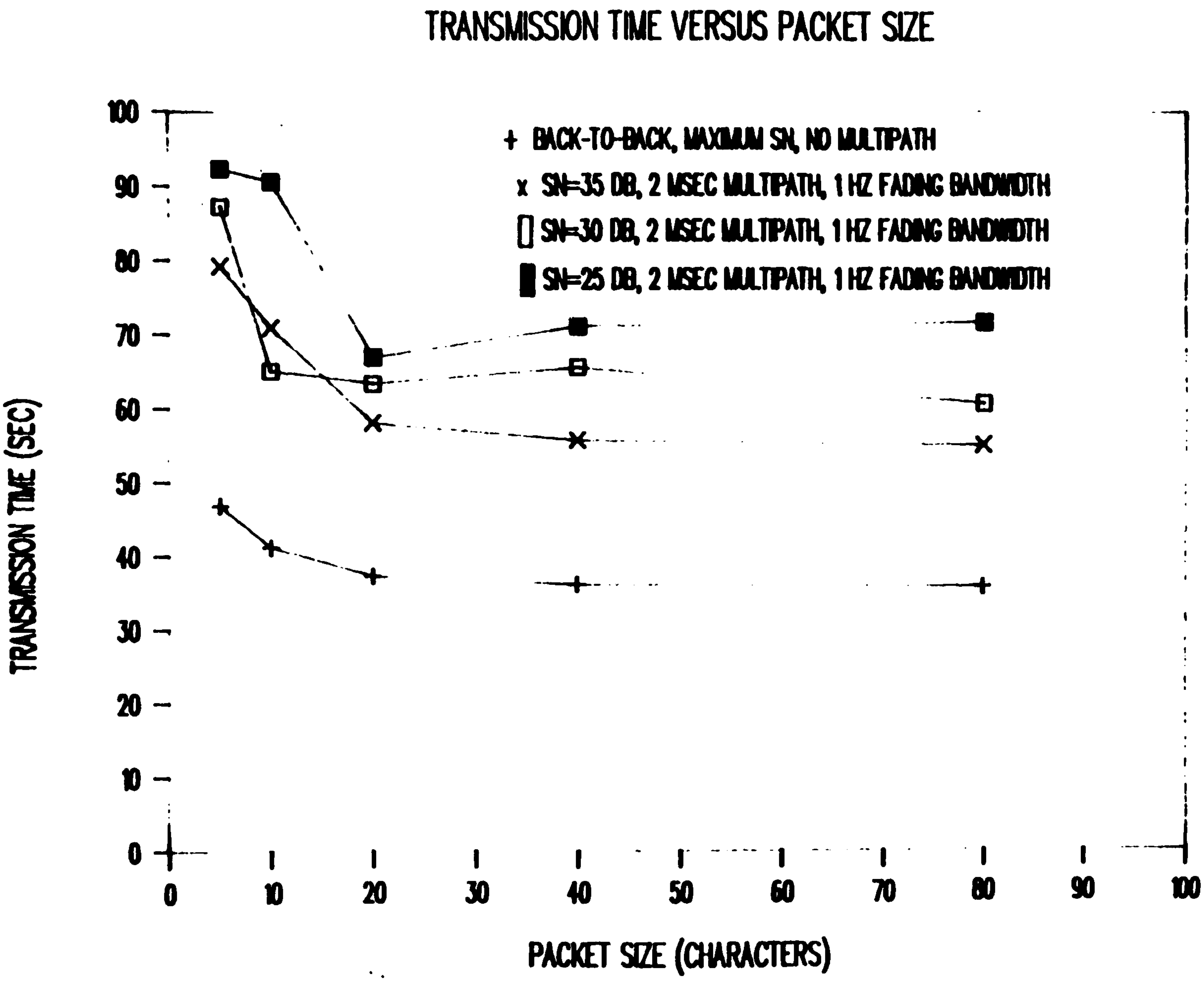


Figure B-56. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous, Medium Message

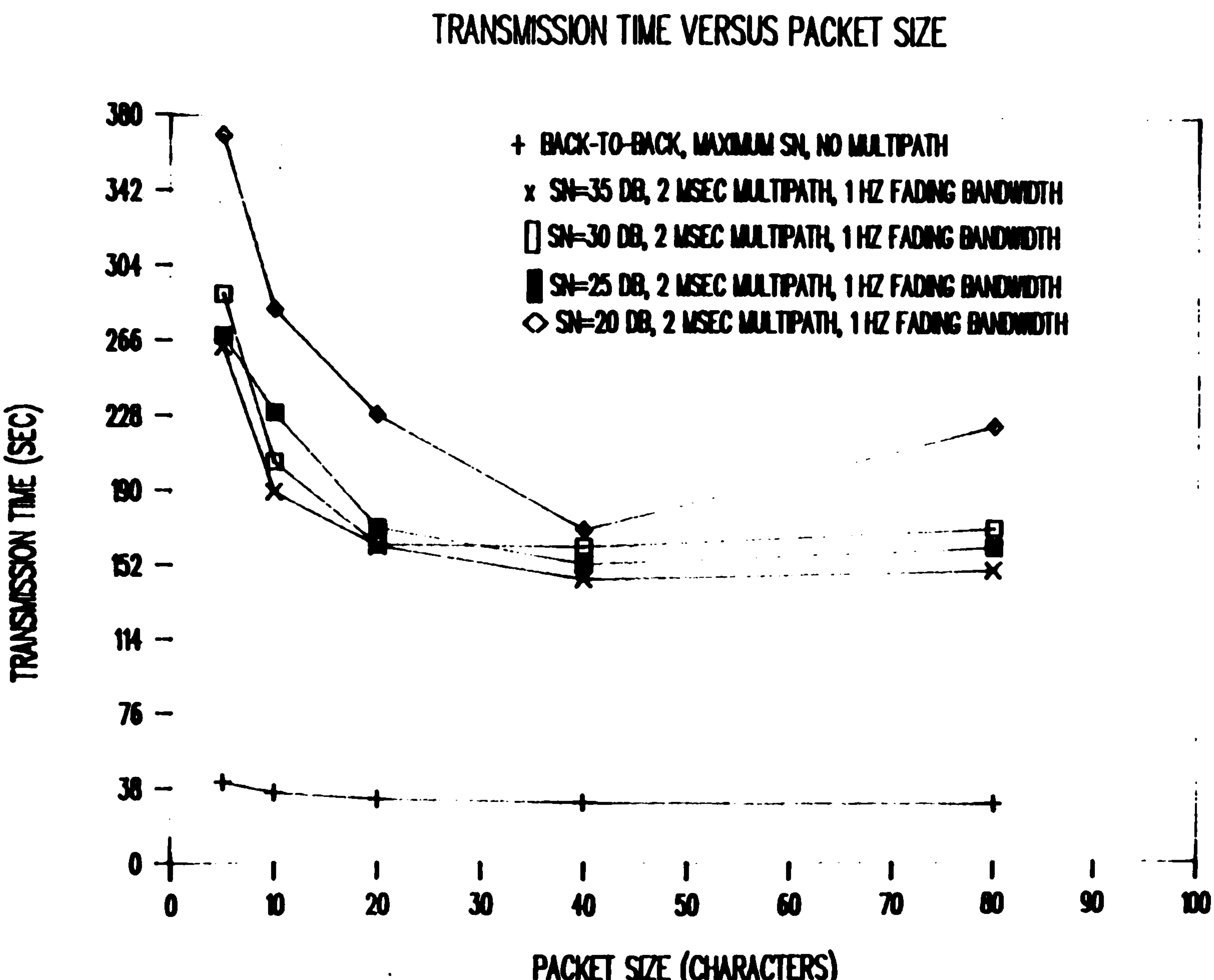


Figure B-57. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous, Medium Message

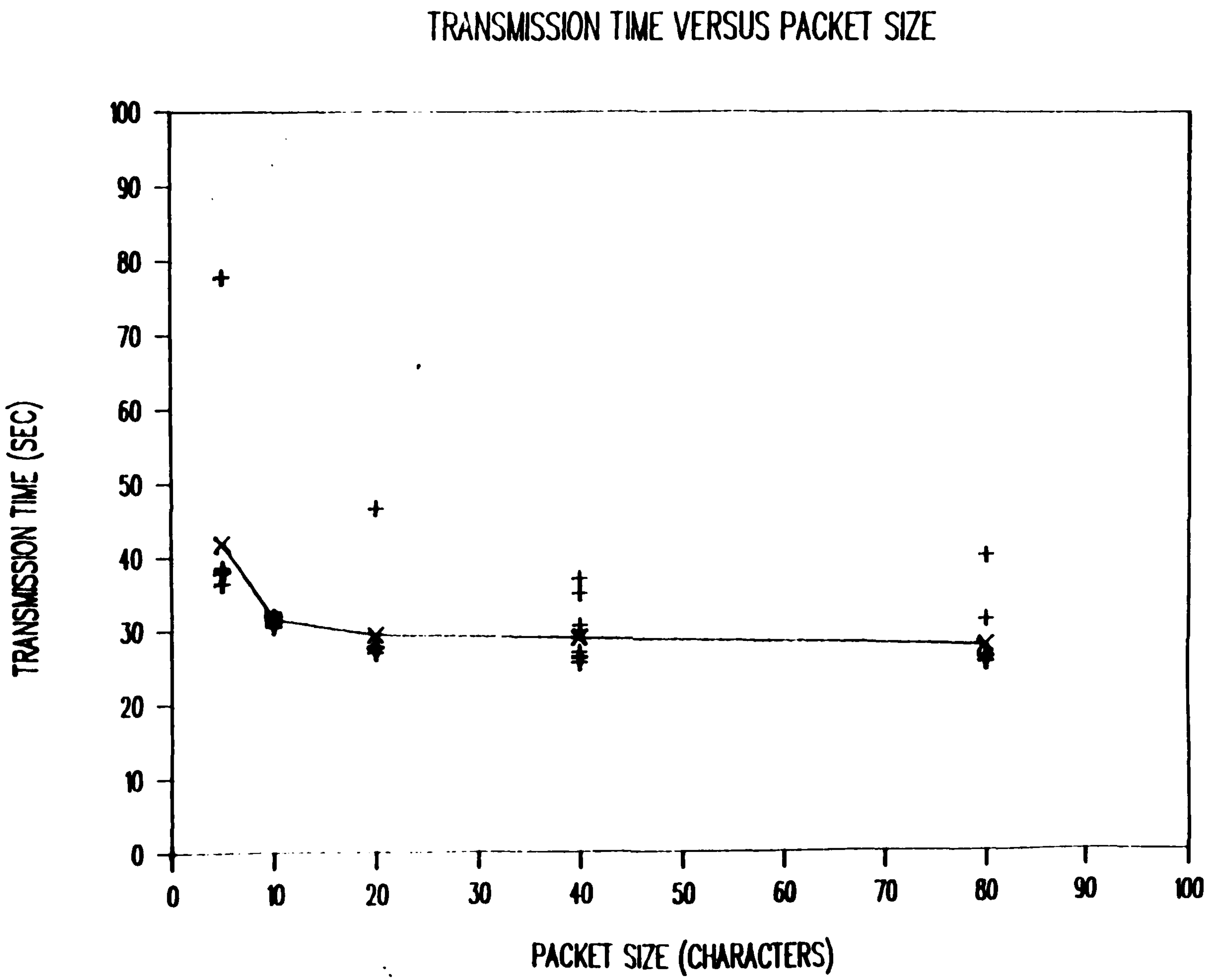


Figure B-58. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message SN = 25 DB

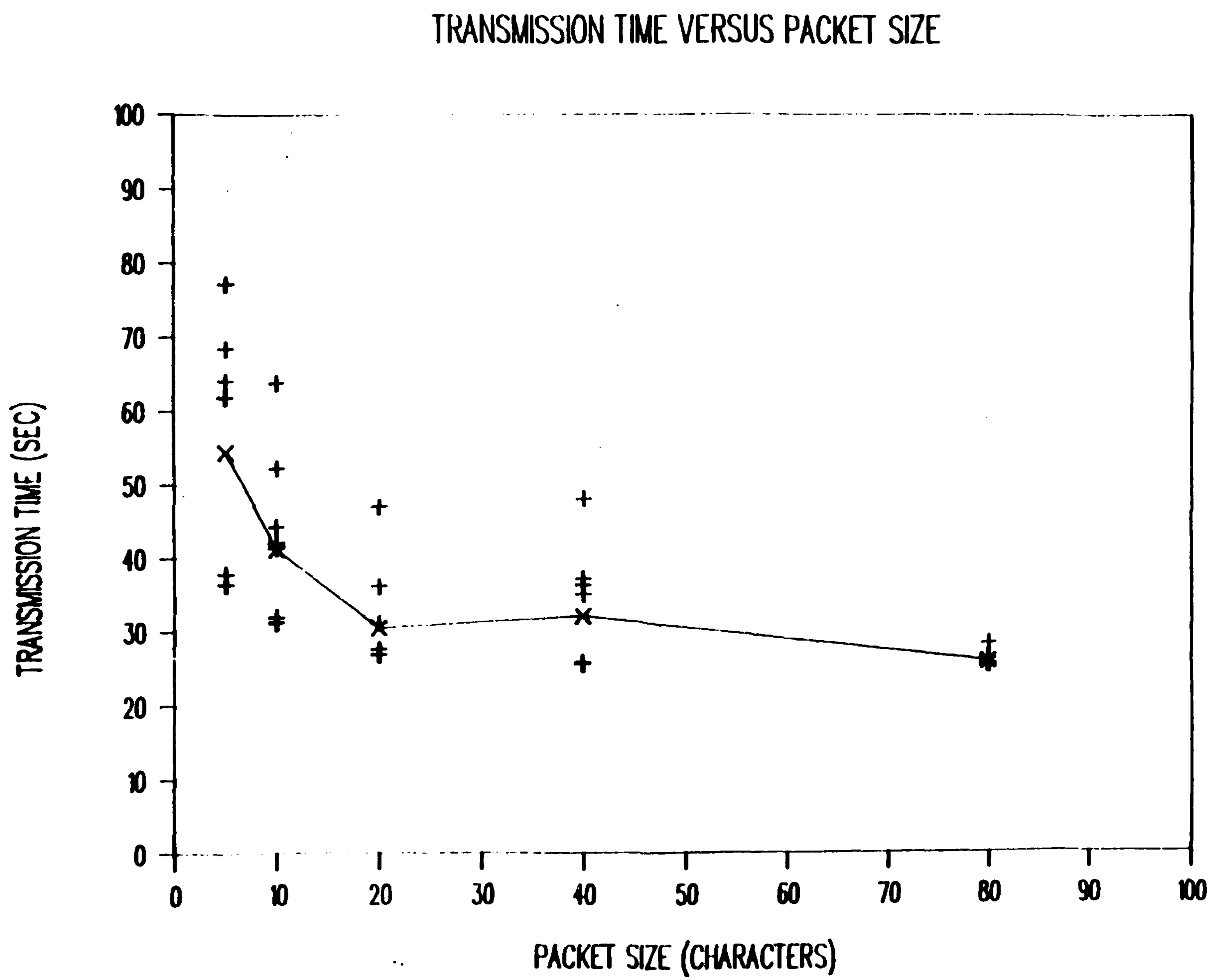


Figure B-59. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 20 DB

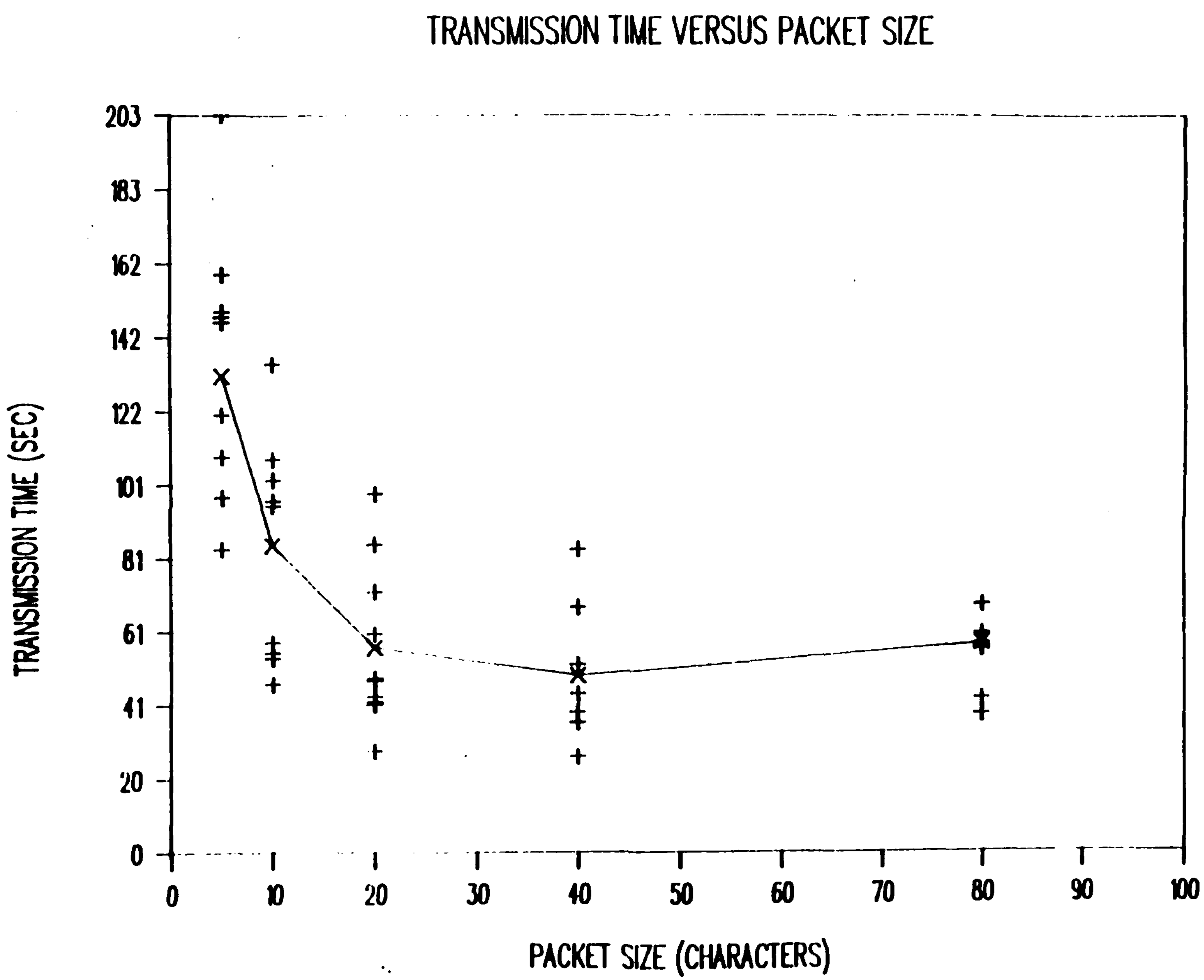


Figure B-60. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 15 DB

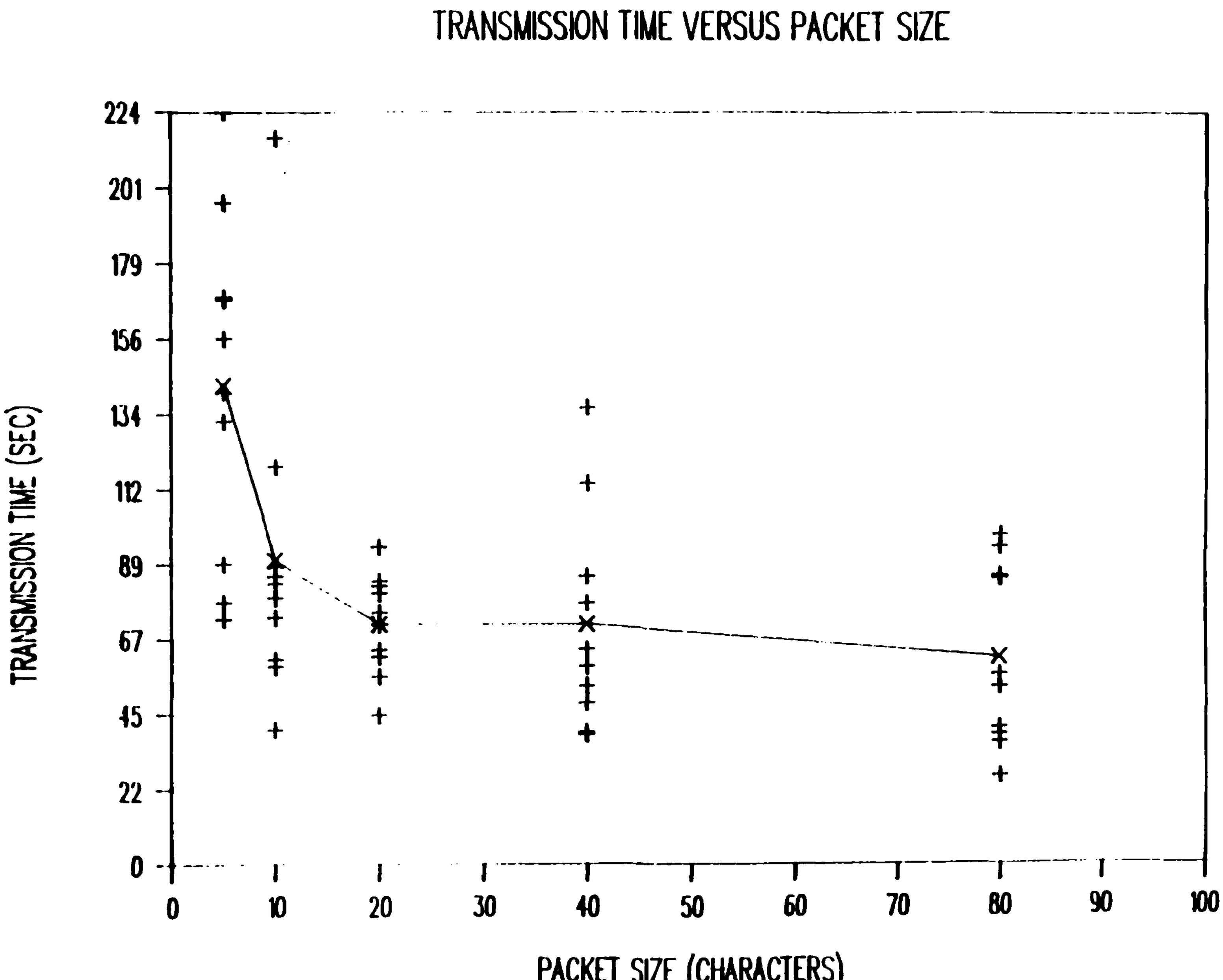


Figure B-61. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 13 DB

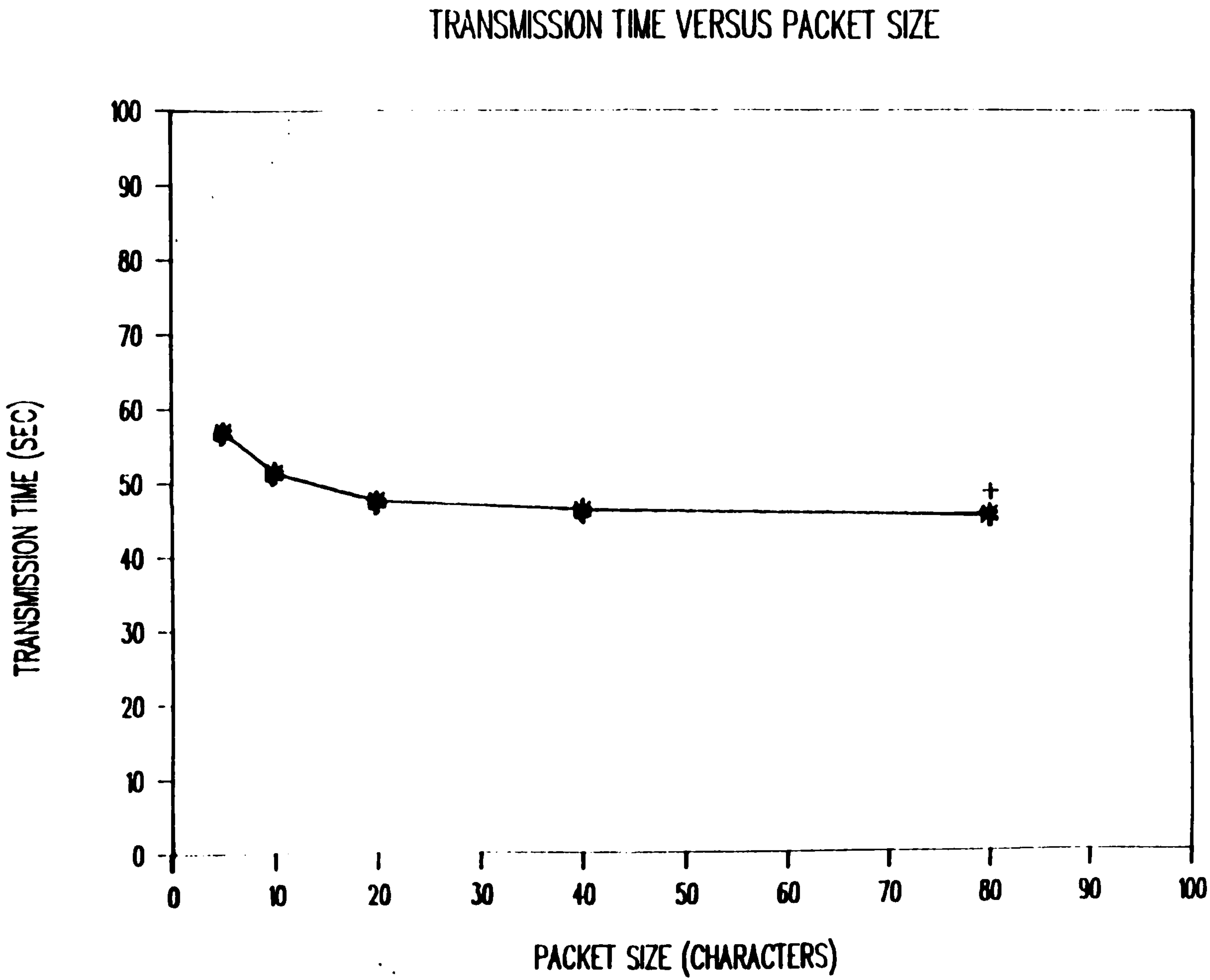


Figure B-62. RF-3466 Modem, 1200 b/s, 12.5 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 25 DB

TRANSMISSION TIME VERSUS PACKET SIZE

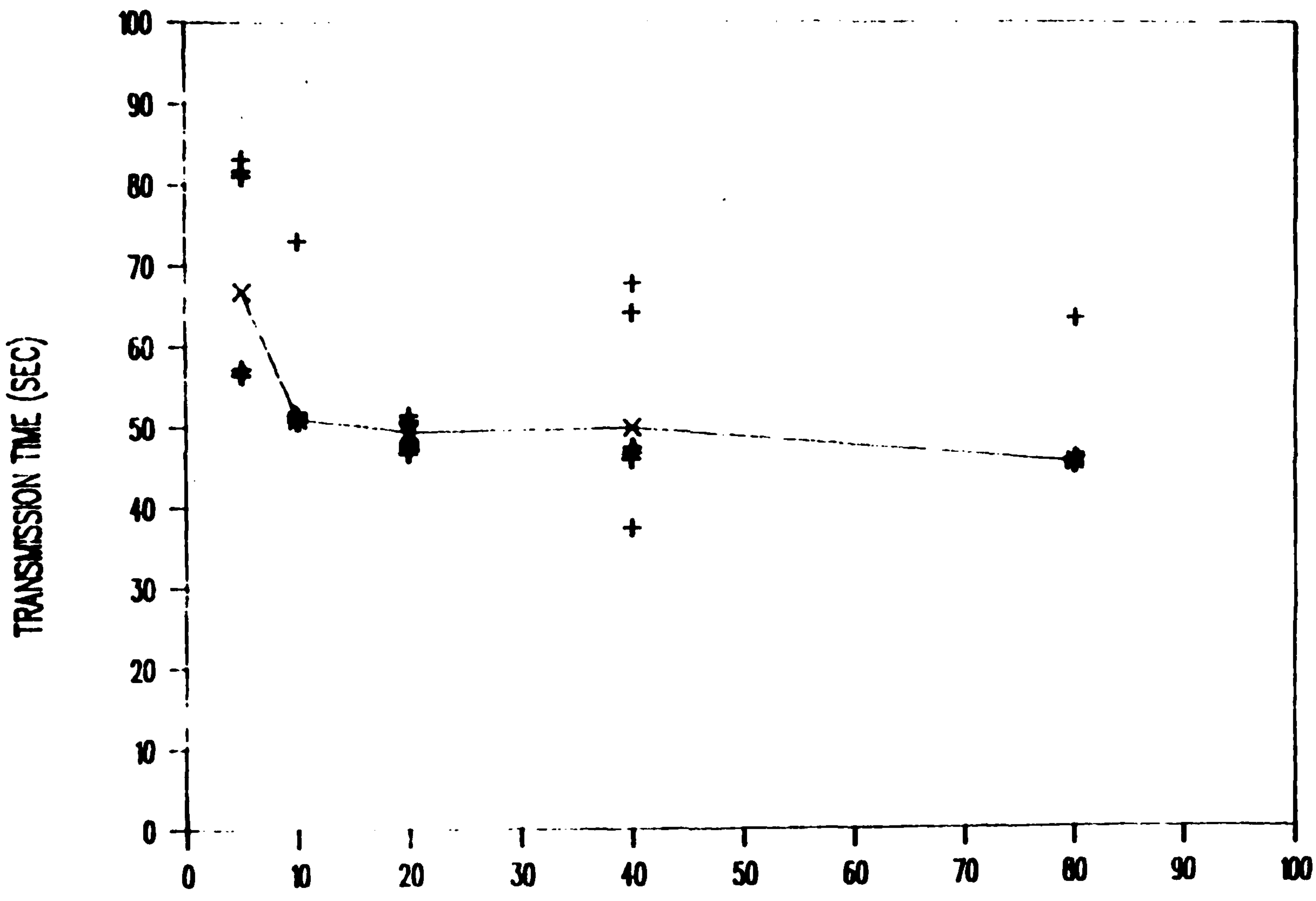


Figure B-63. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 20 DB

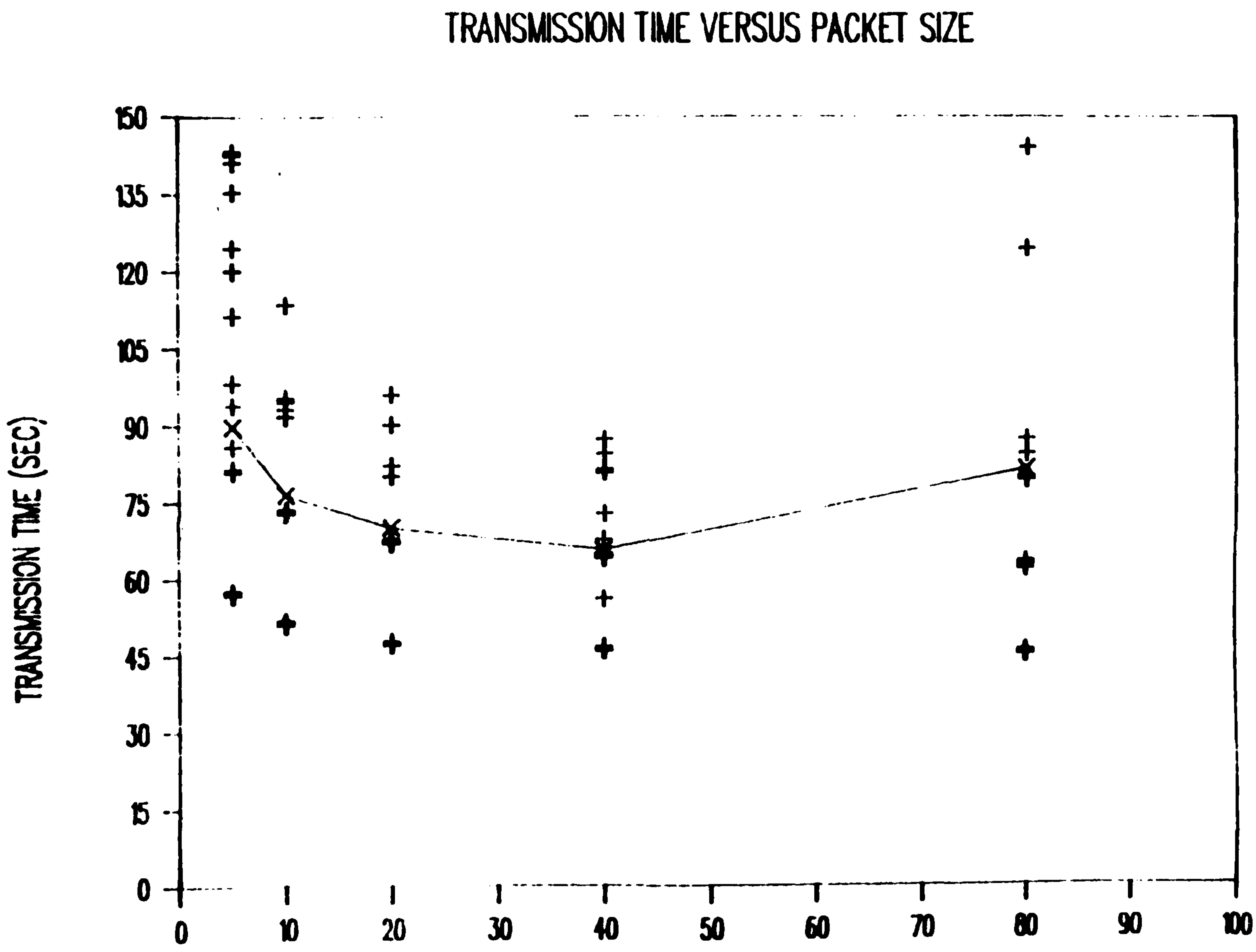


Figure B-64. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 15 DB

TRANSMISSION TIME VERSUS PACKET SIZE

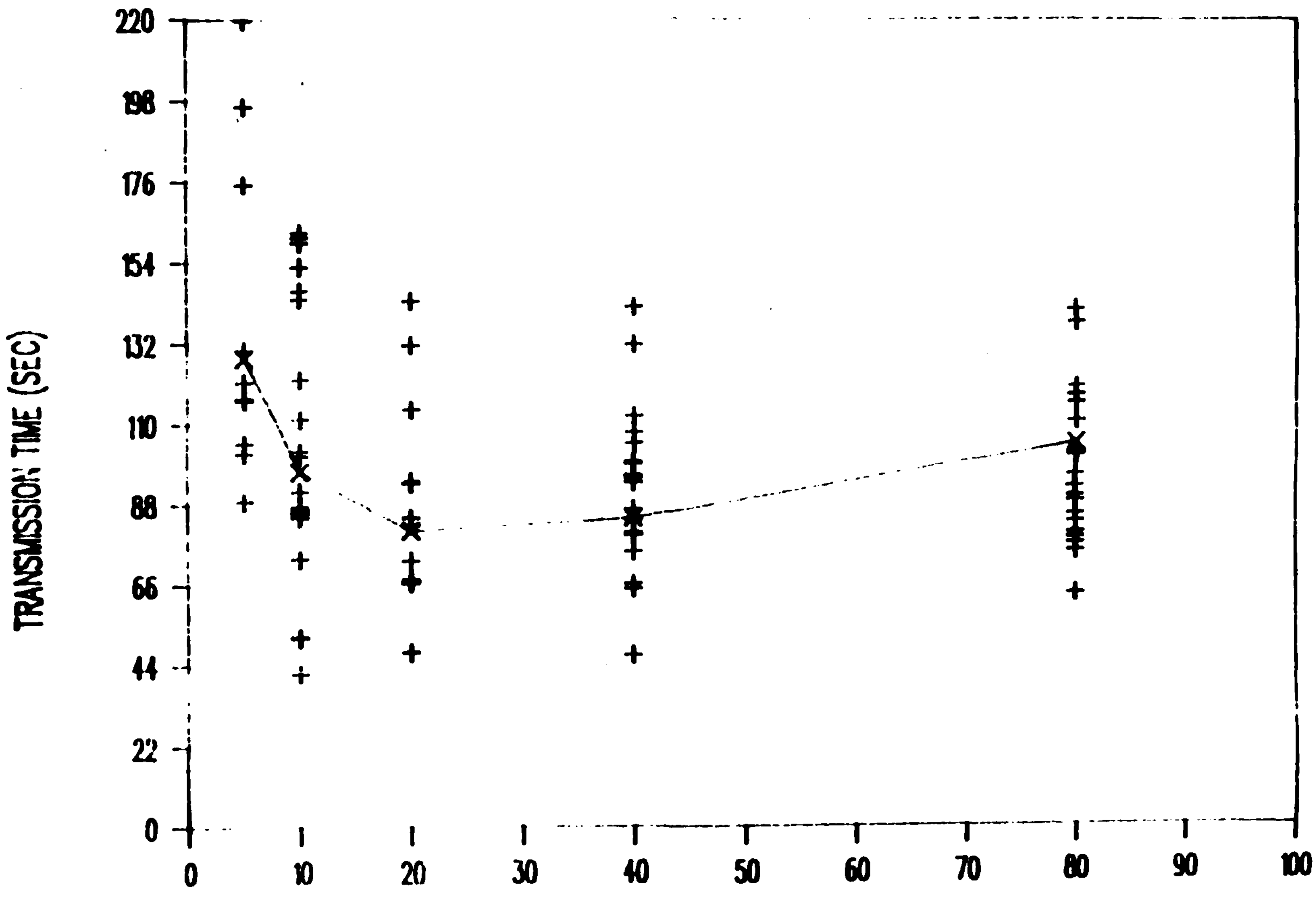


Figure B-65. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 13 DB

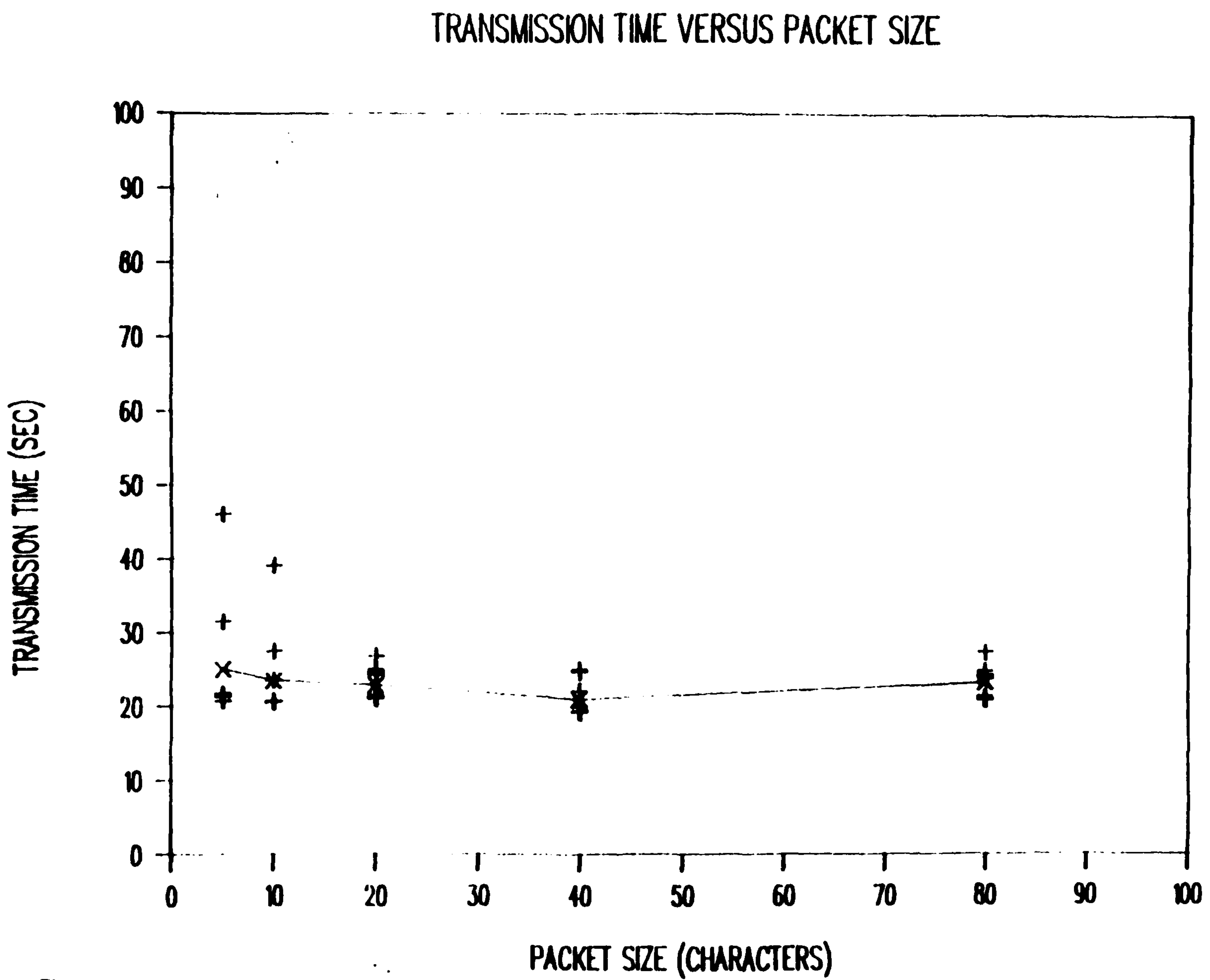


Figure B-66. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 30 DB

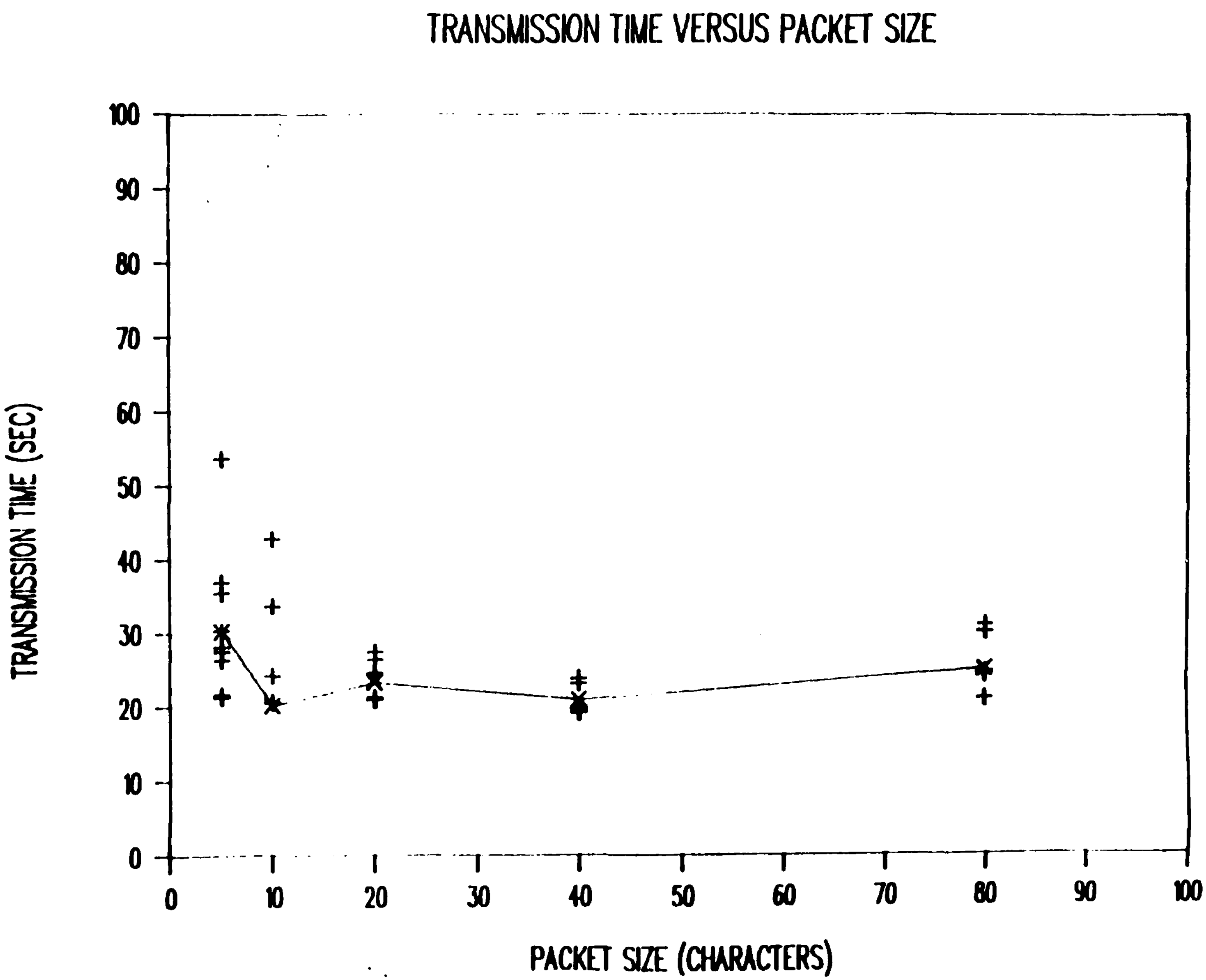


Figure B-67. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 25 DB

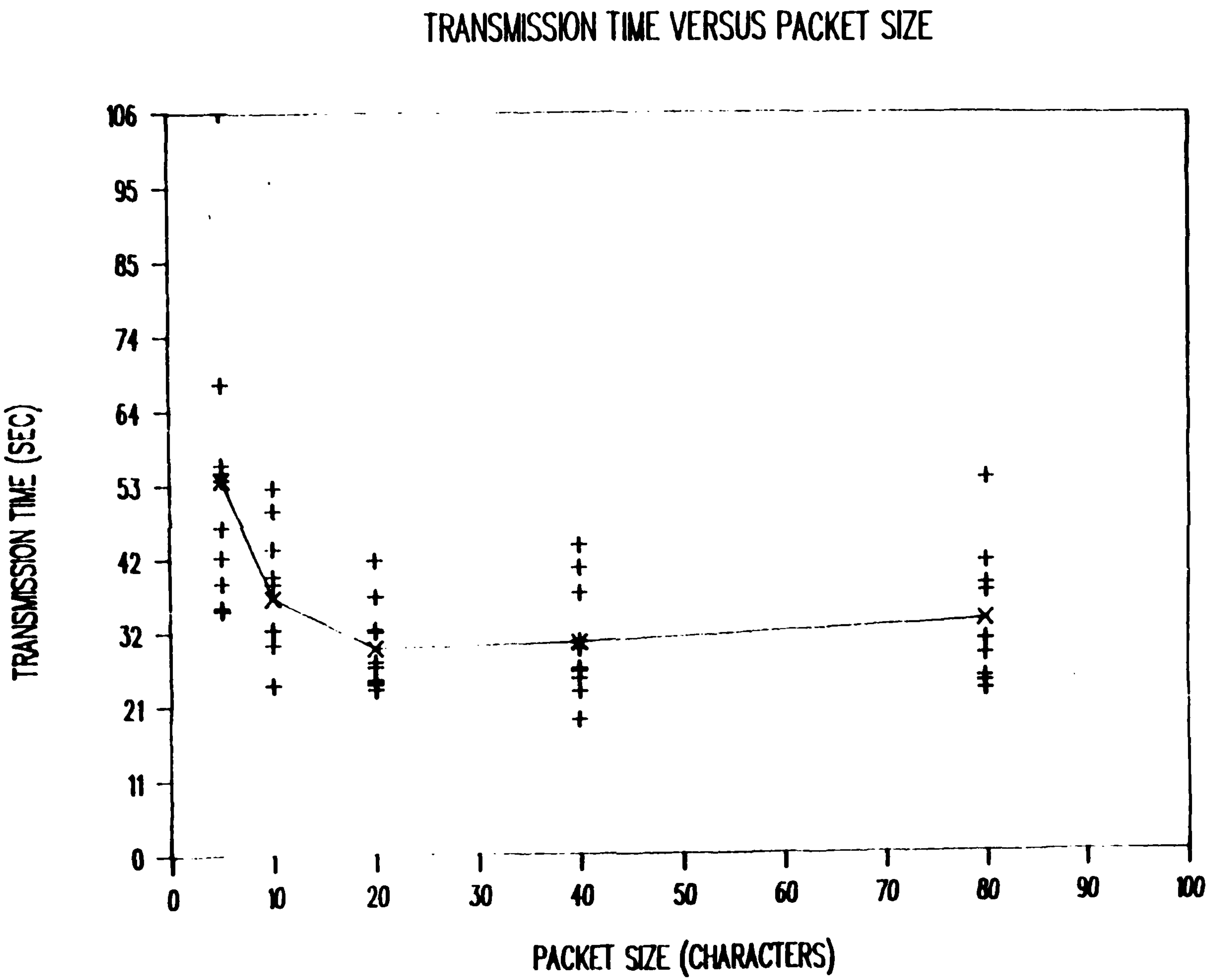


Figure B-68. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 20 DB

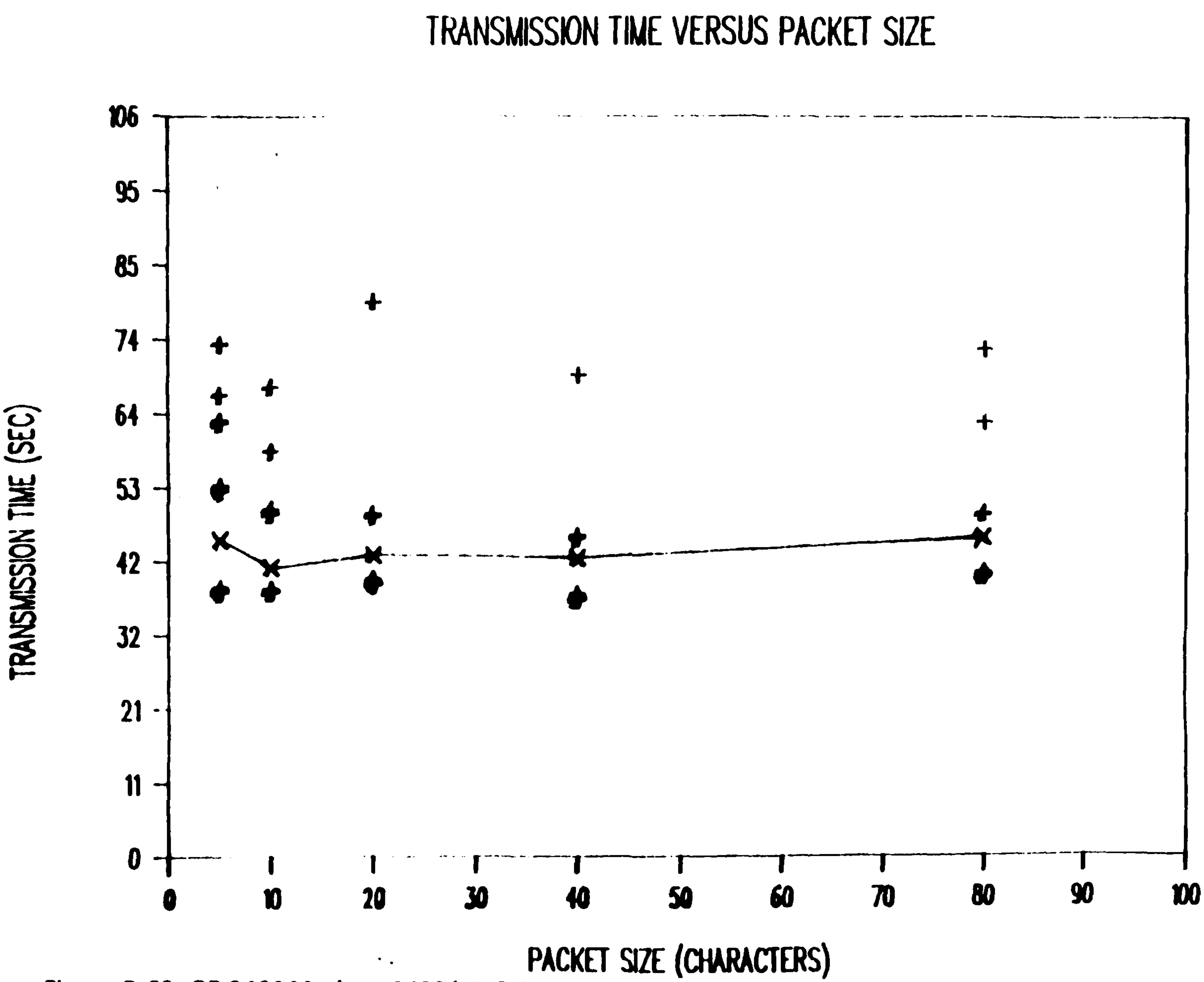


Figure B-69. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous, Medium Message SN = 30 DB

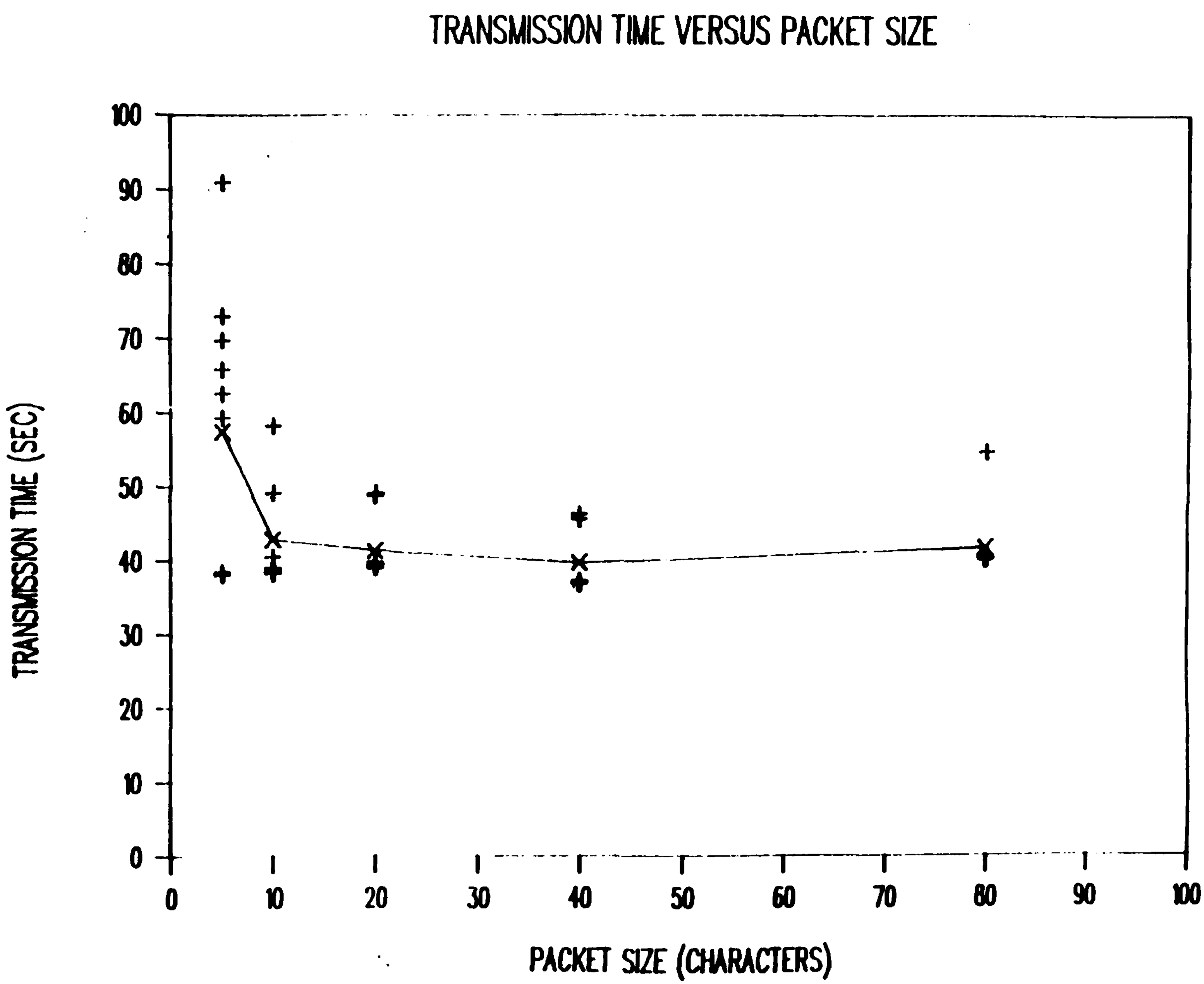


Figure B-70. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 25 DB

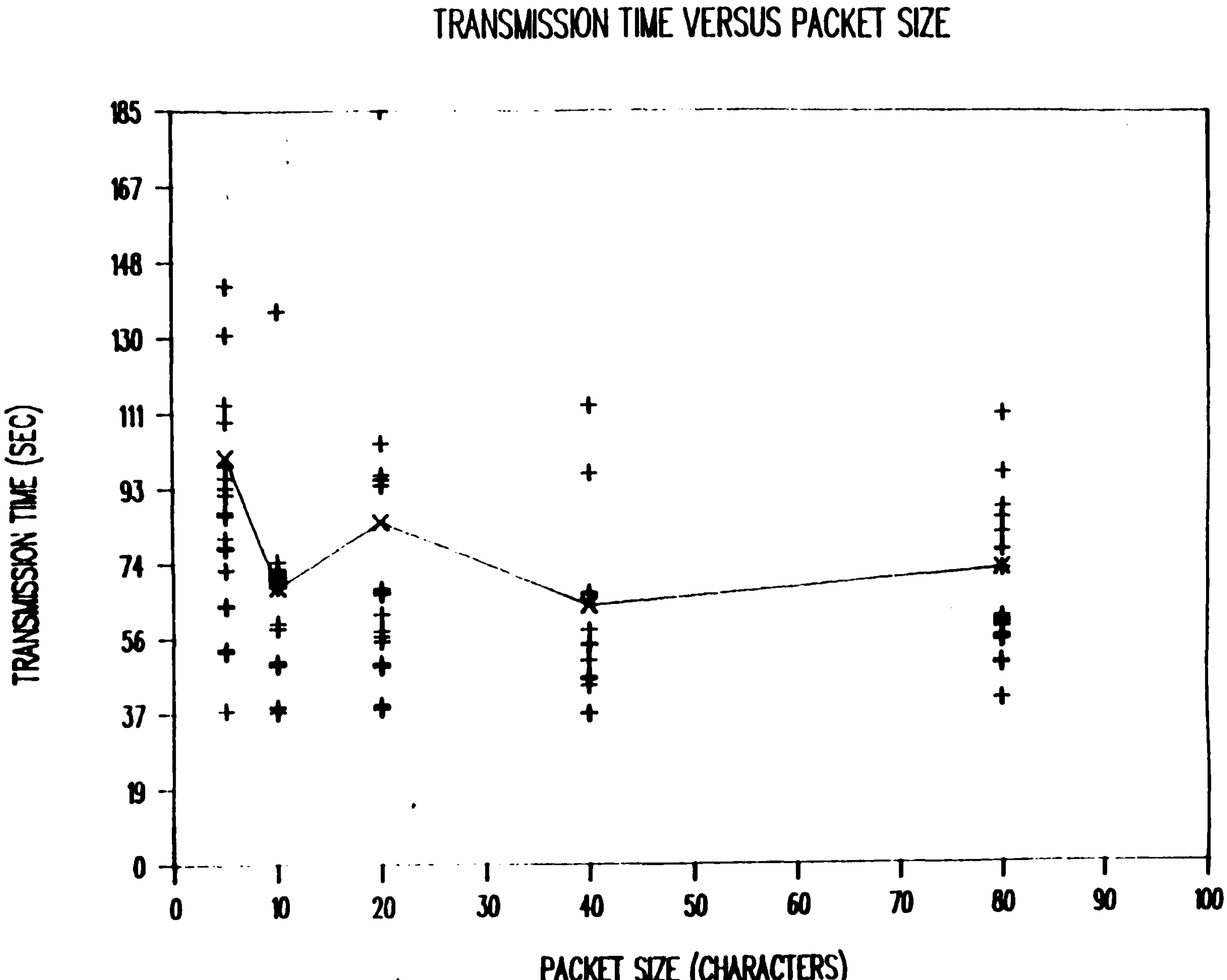


Figure B-71. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 20 DB

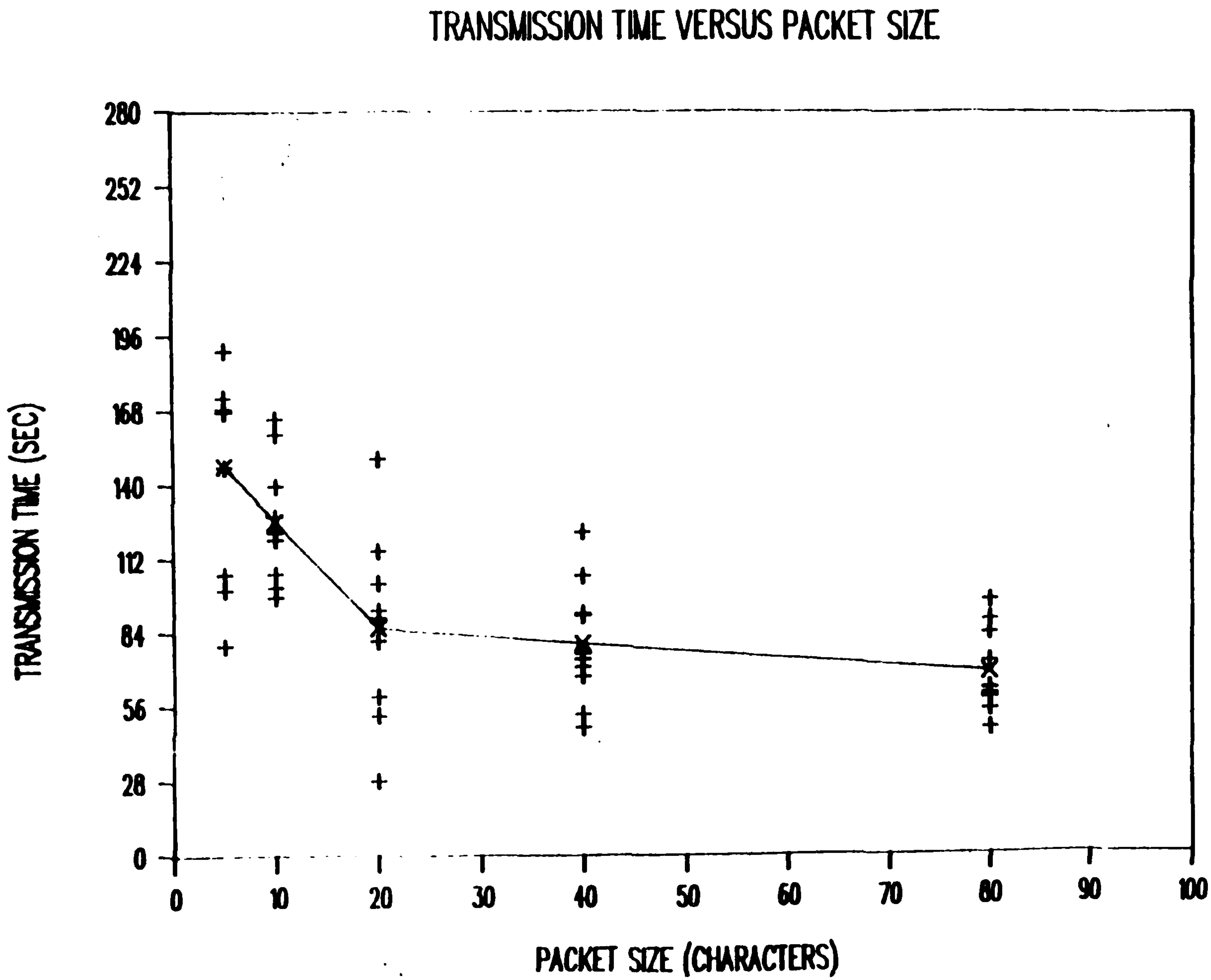


Figure B-72. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 35 DB

TRANSMISSION TIME VERSUS PACKET SIZE

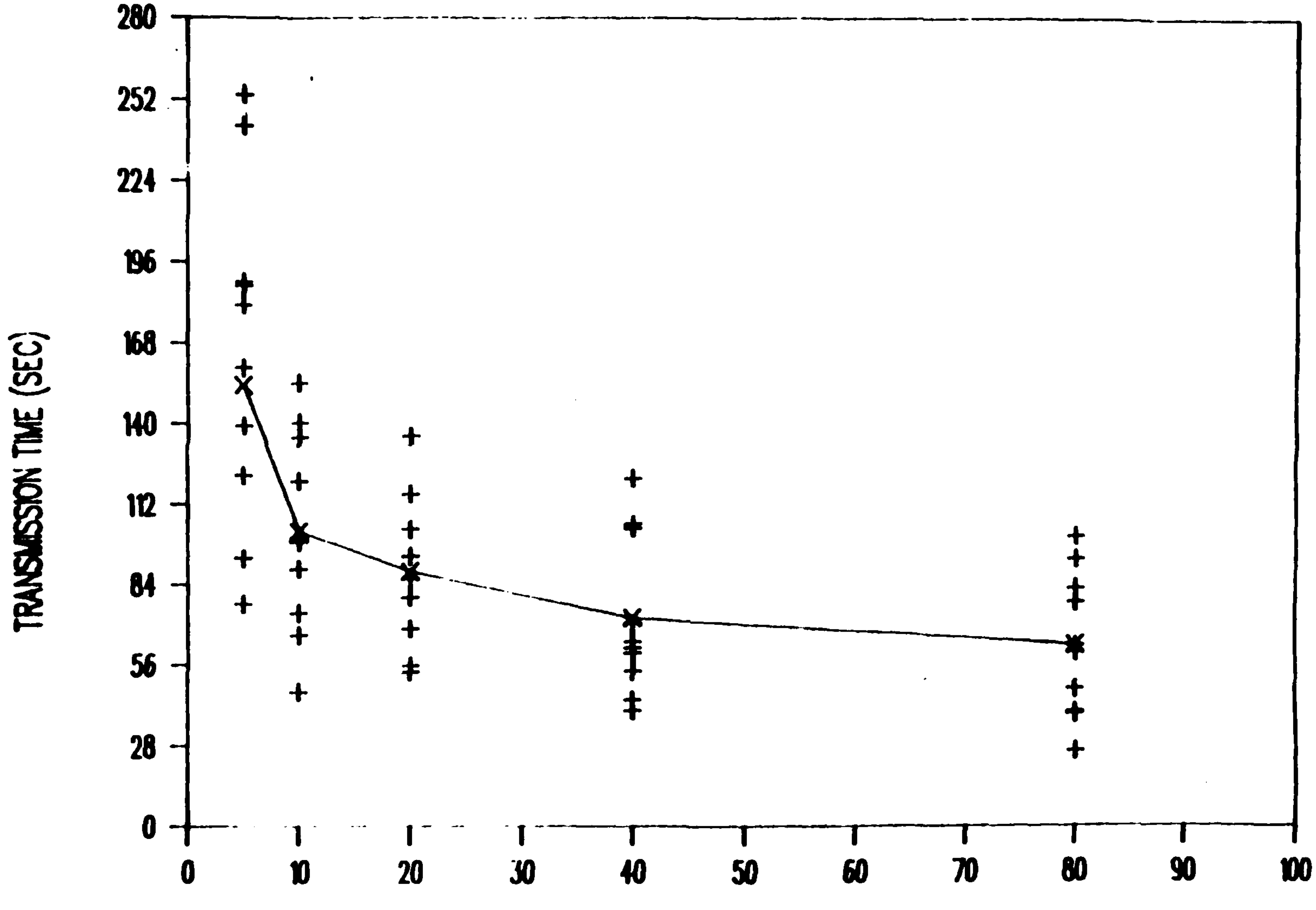


Figure B-73. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 30 DB

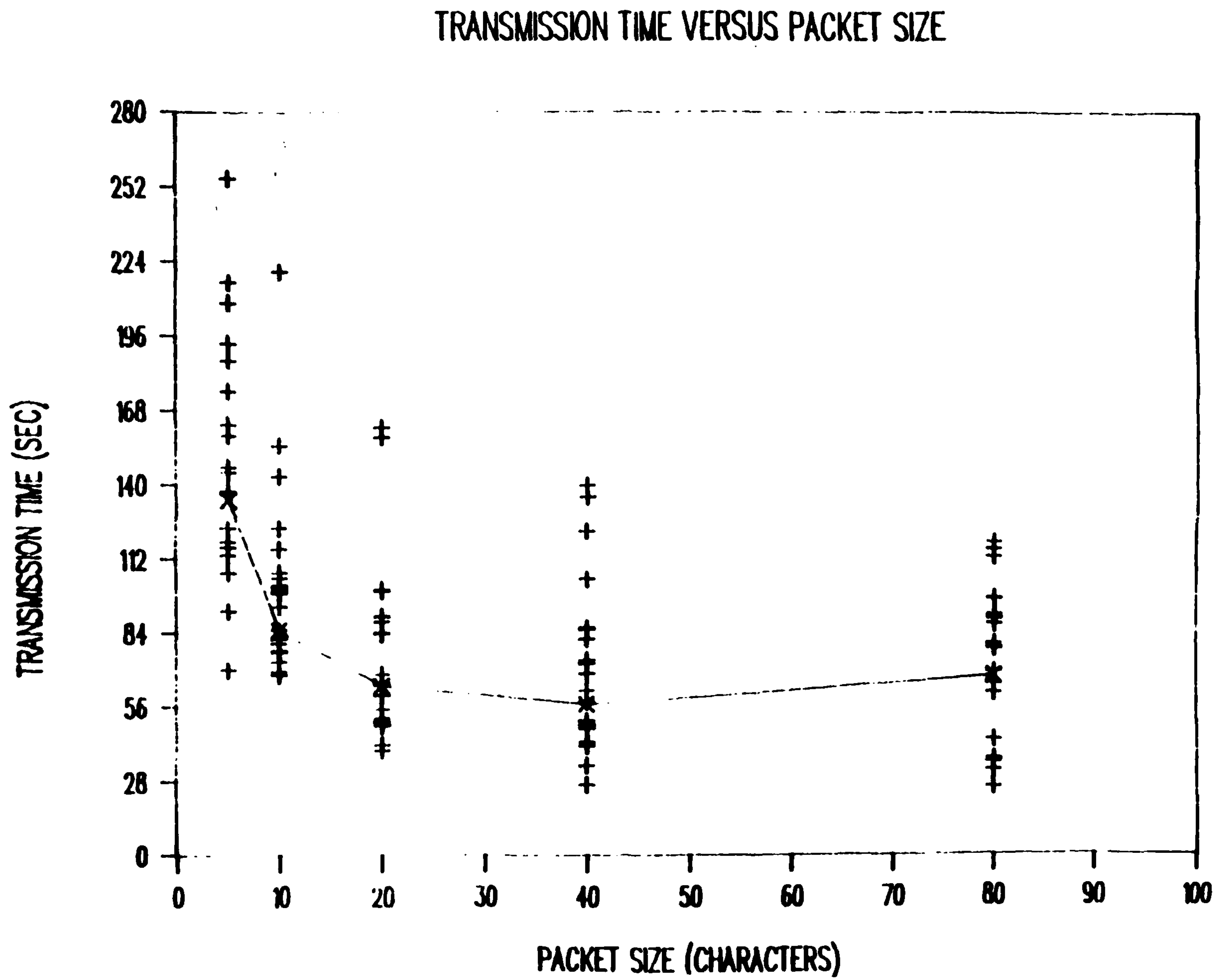


Figure B-74. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 25 DB

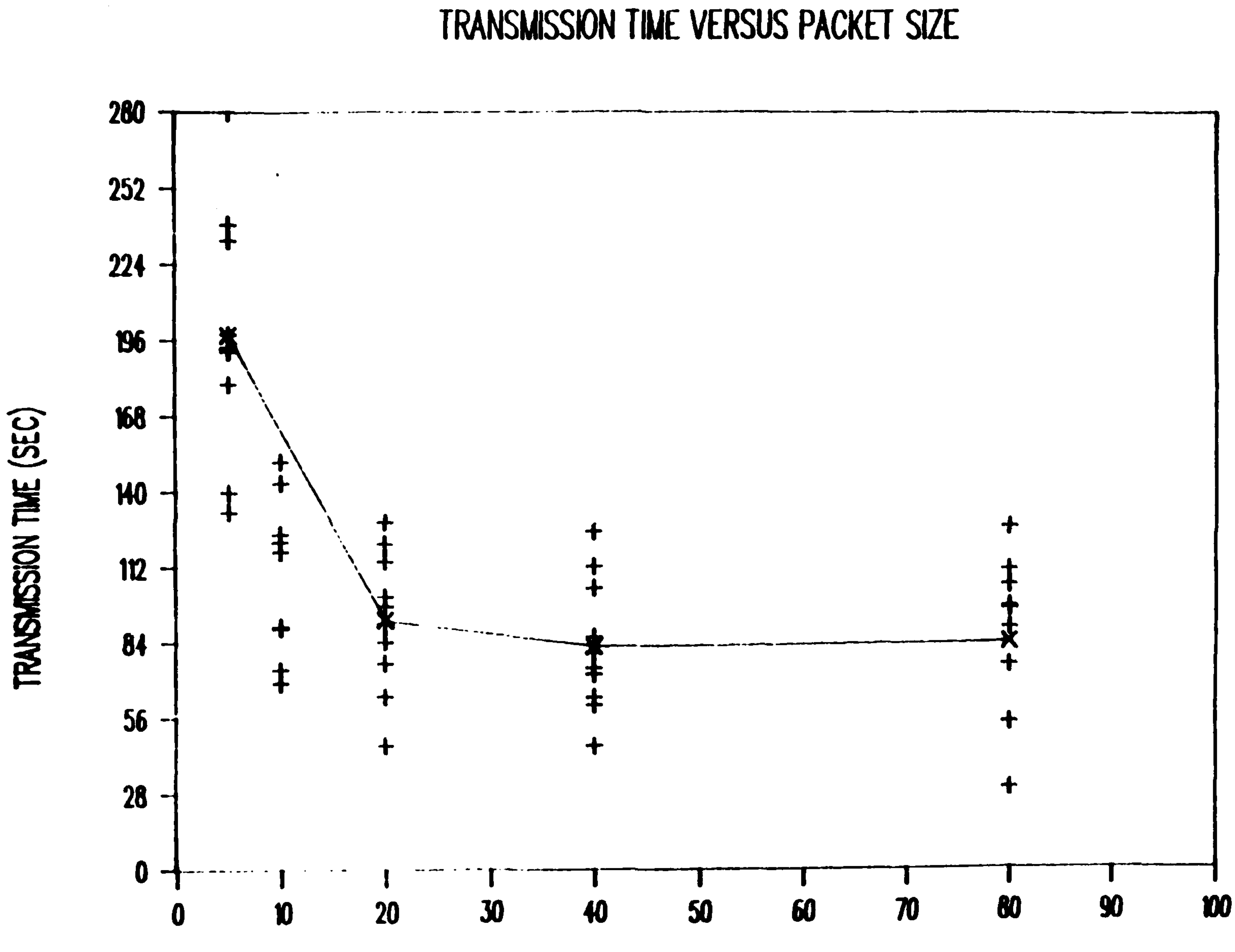


Figure B-75. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 20 DB

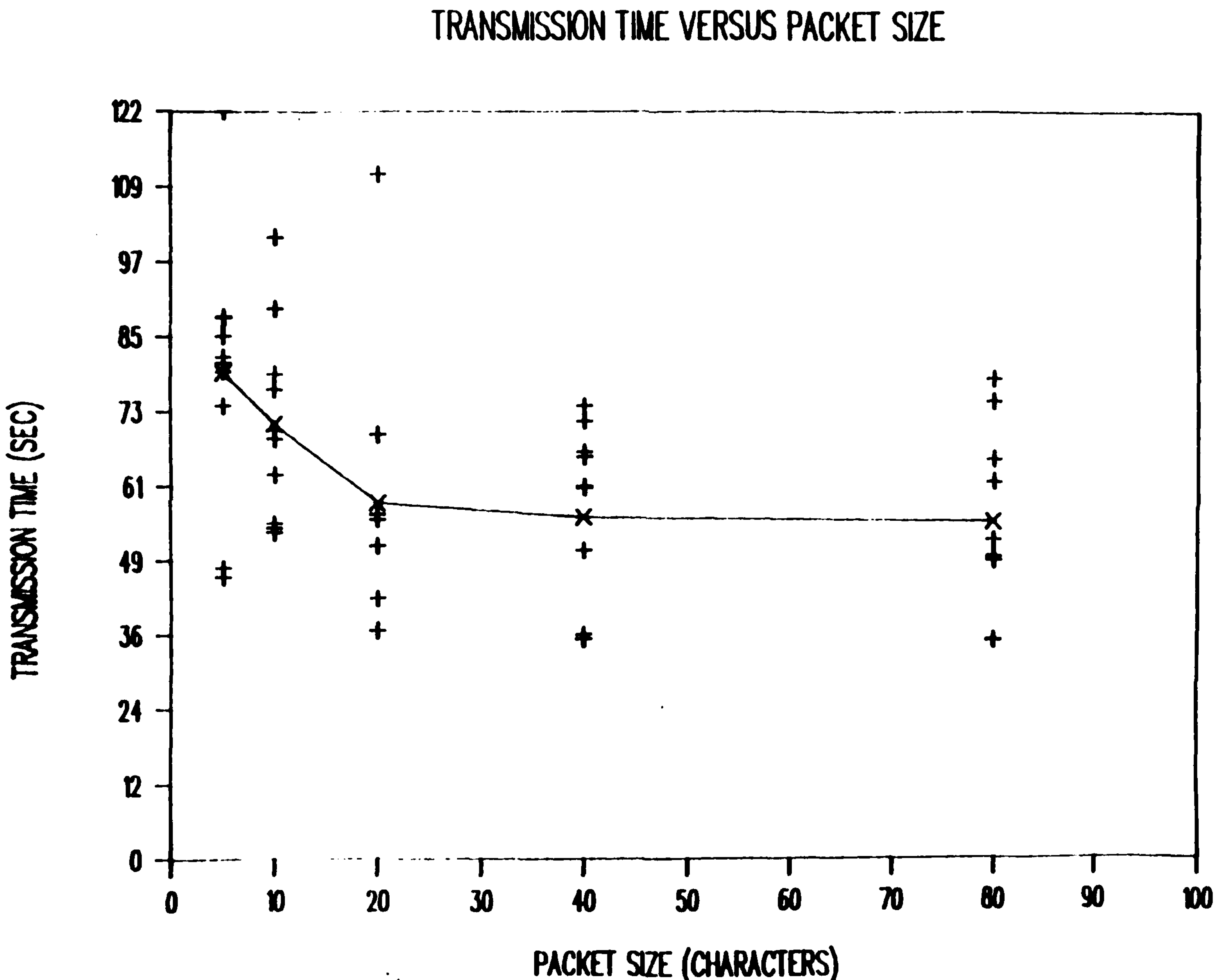


Figure B-76. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 35 DB

TRANSMISSION TIME VERSUS PACKET SIZE

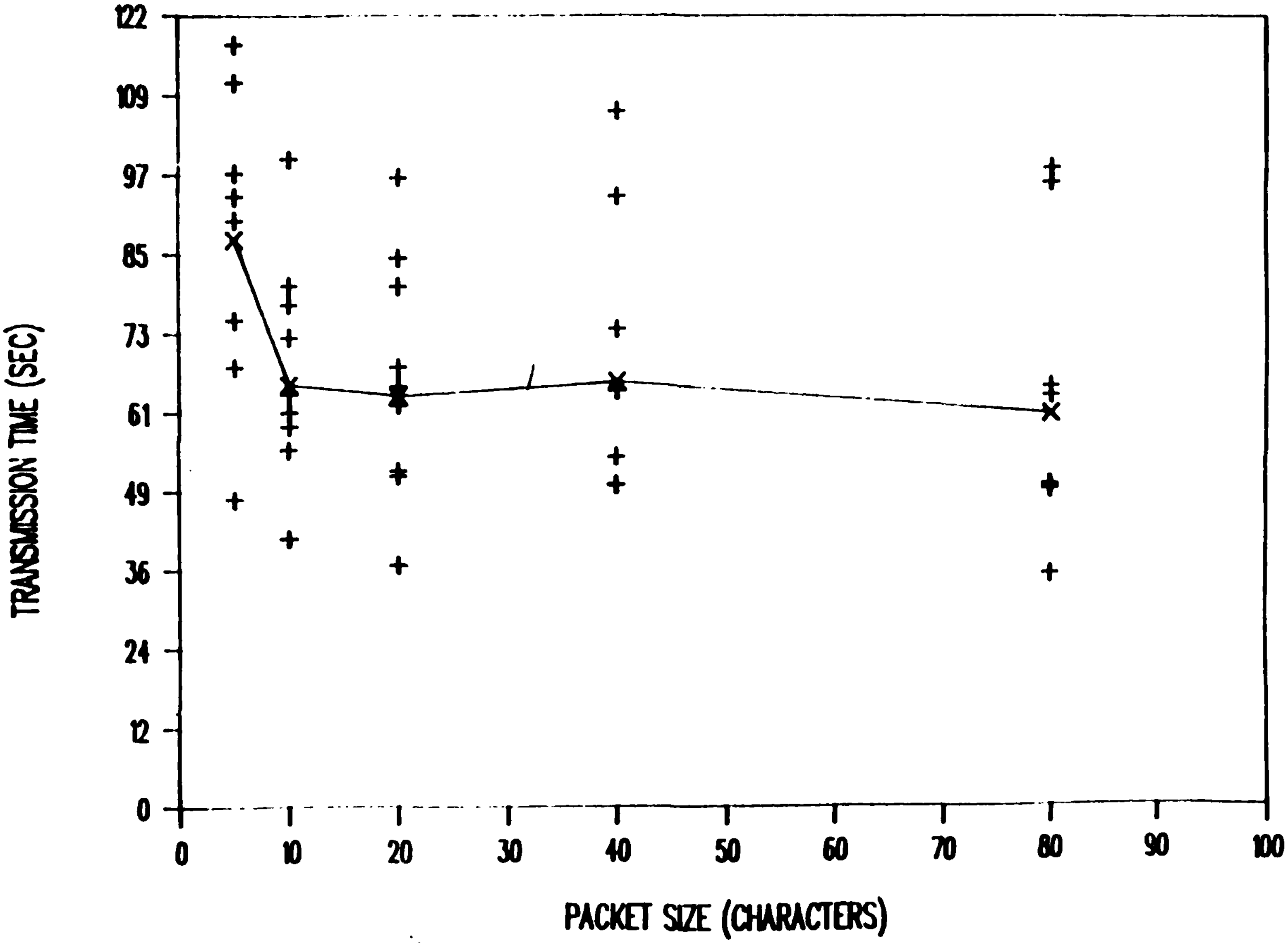


Figure B-77. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 30 DB

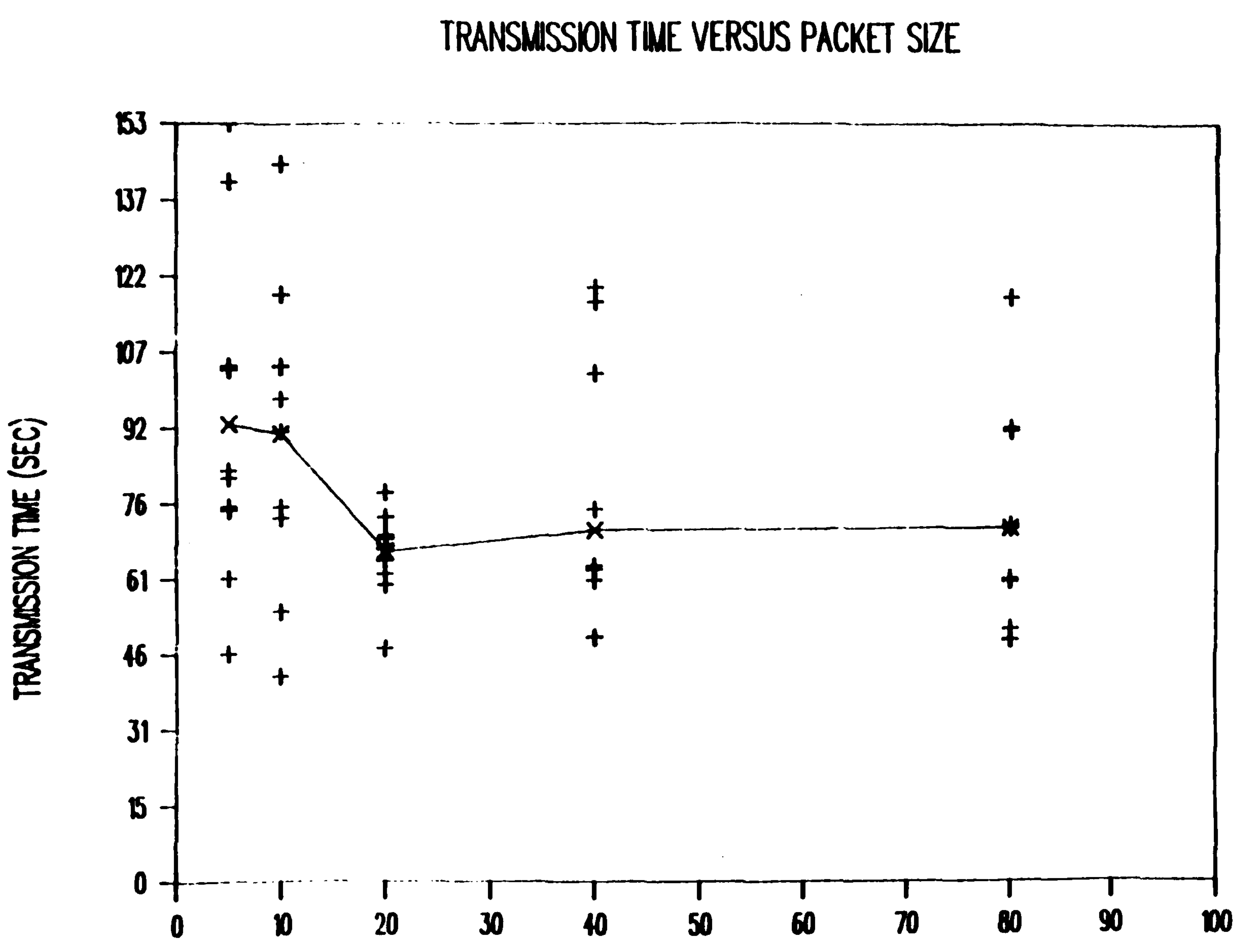


Figure B-78. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 25 DB

TRANSMISSION TIME VERSUS PACKET SIZE

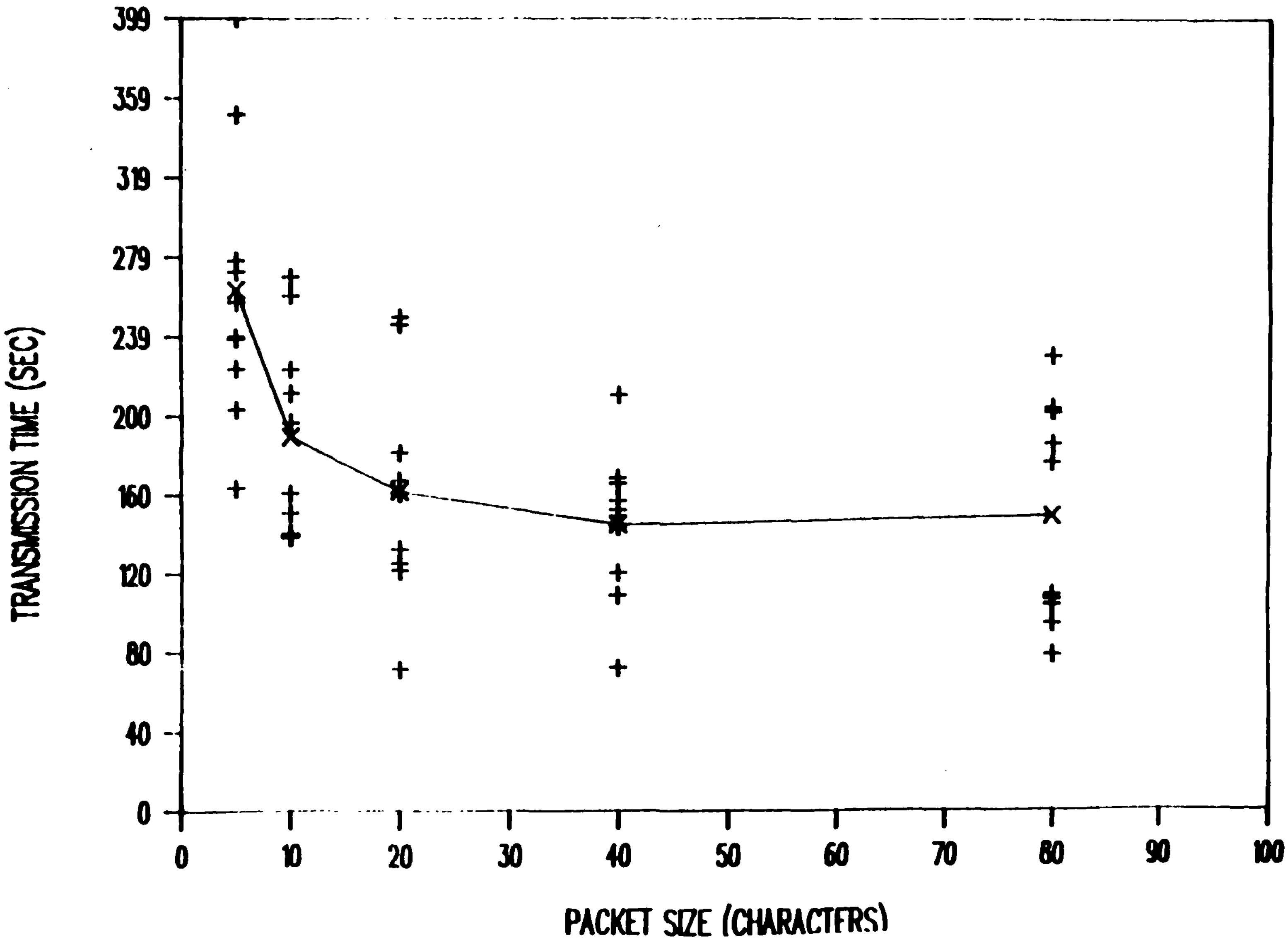


Figure B-79. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 35 DB

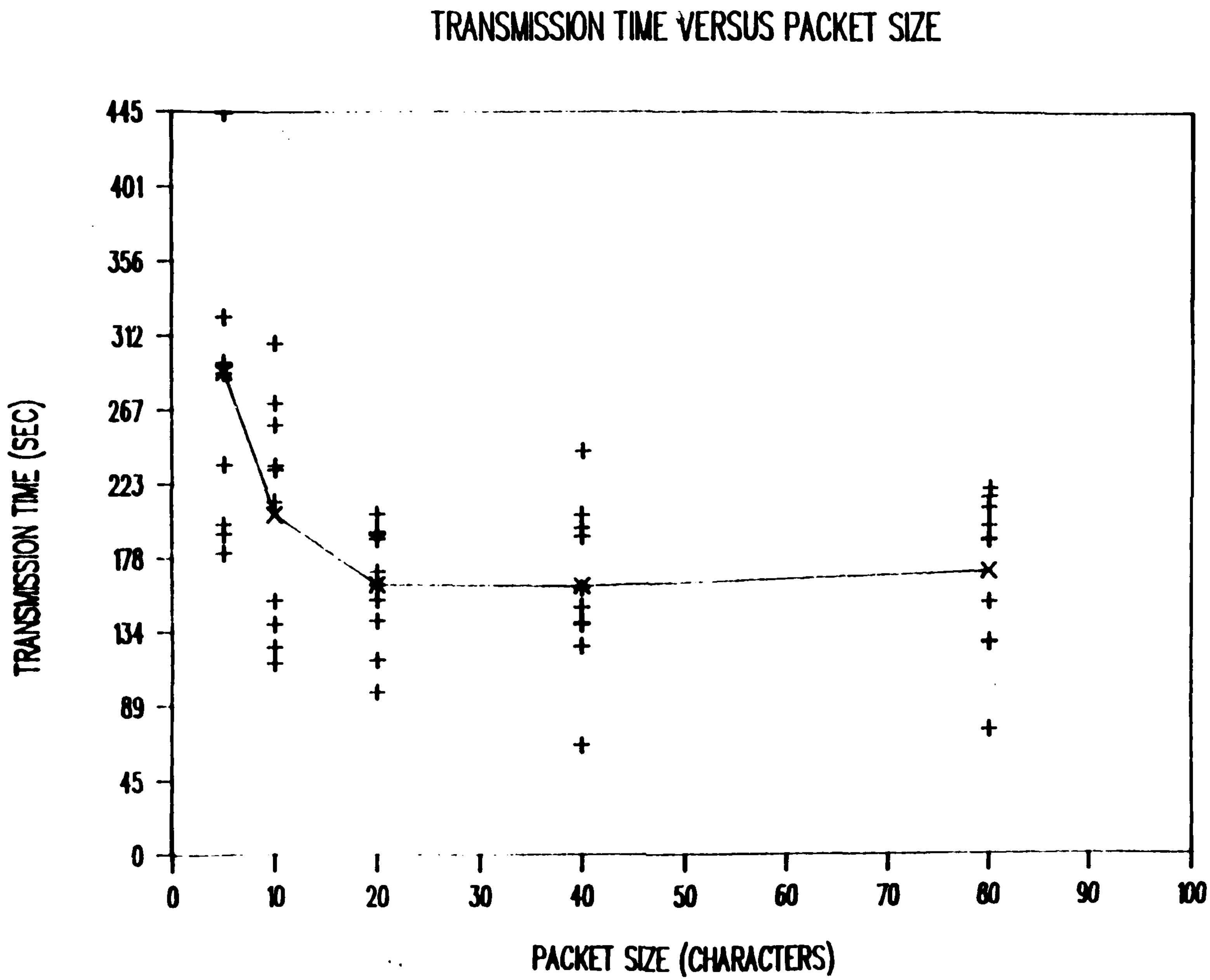


Figure B-80. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 30 DB

TRANSMISSION TIME VERSUS PACKET SIZE

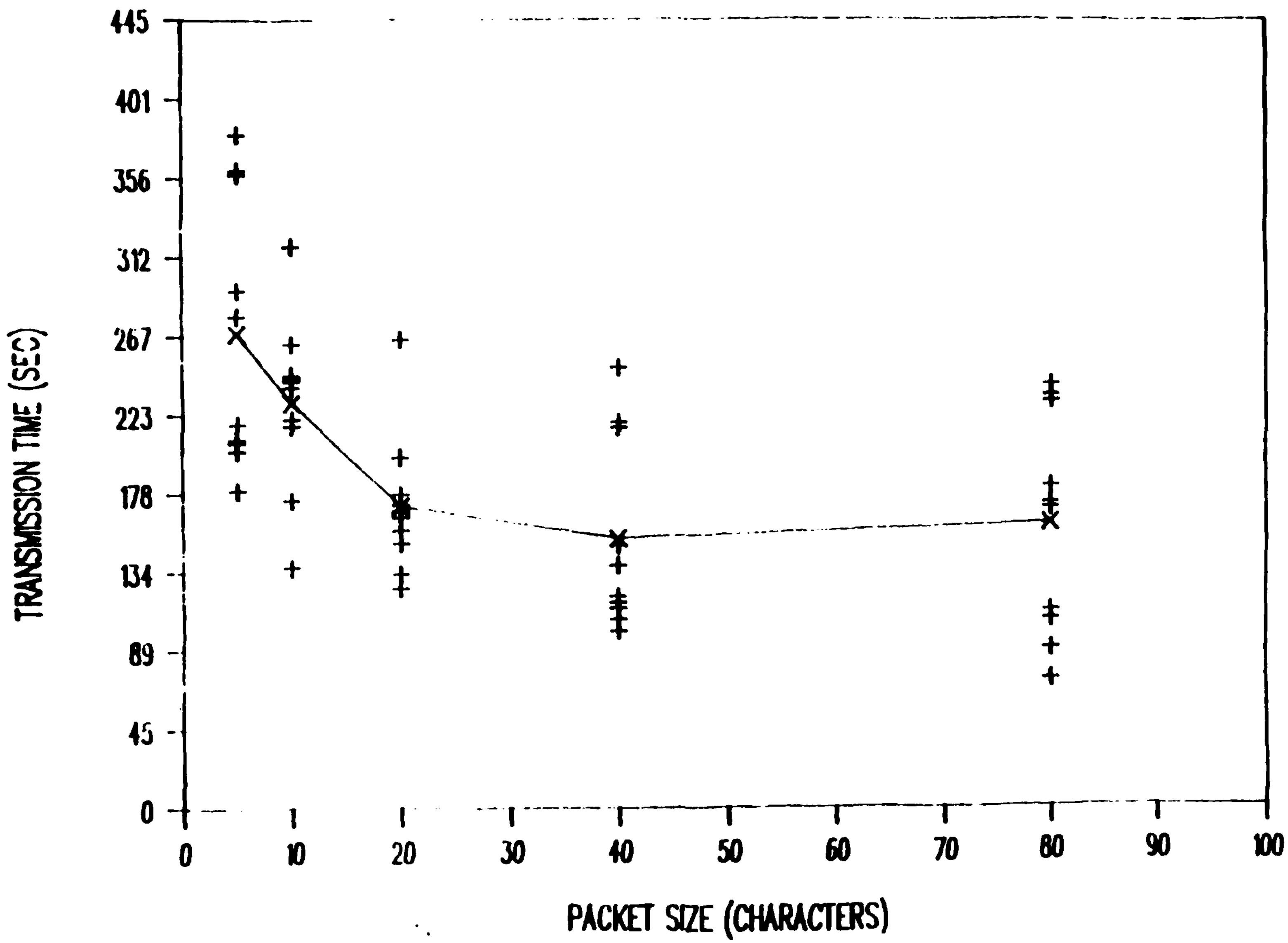


Figure B-81. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 25 DB

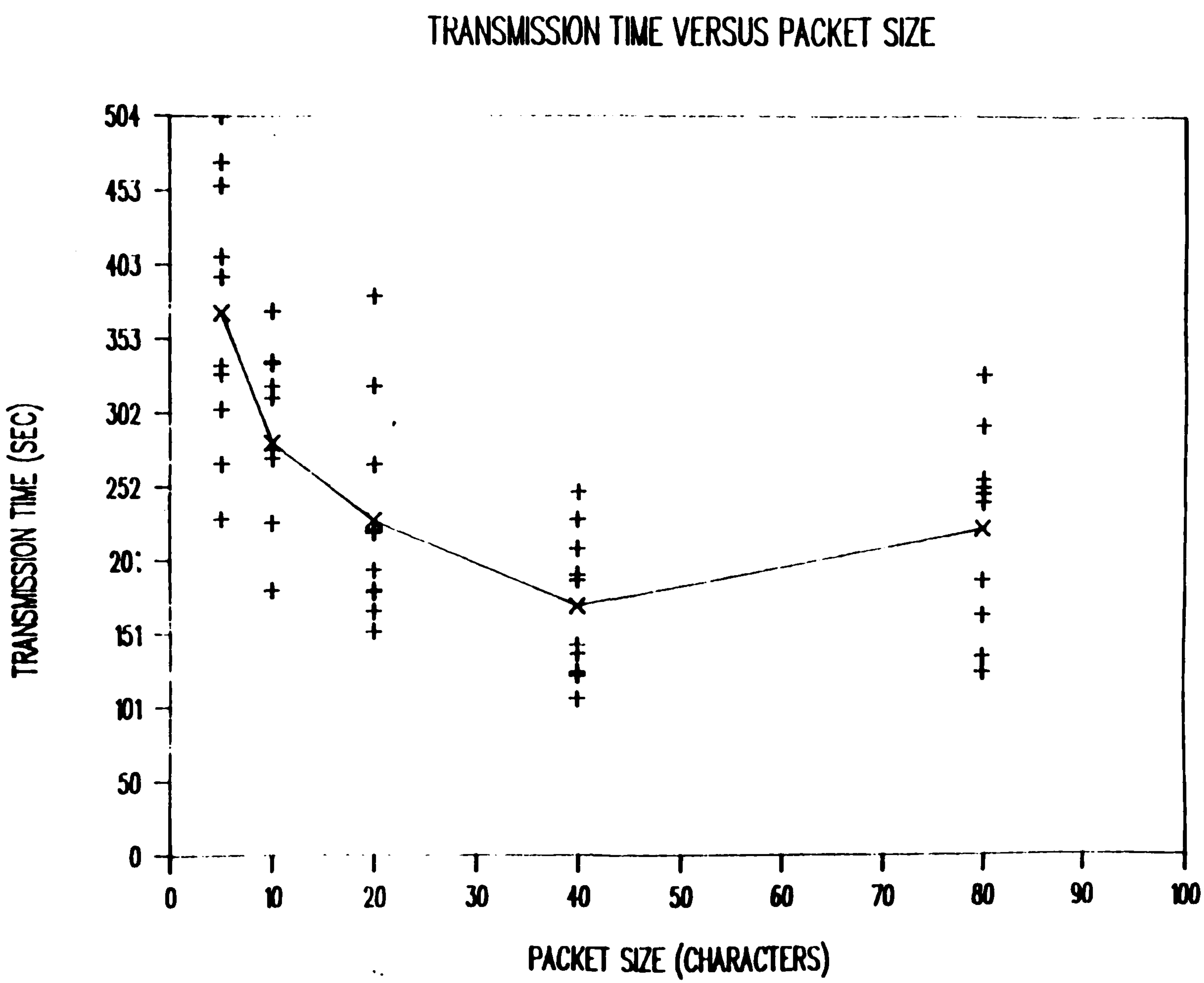


Figure B-82. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous, Medium Message
SN = 20 DB

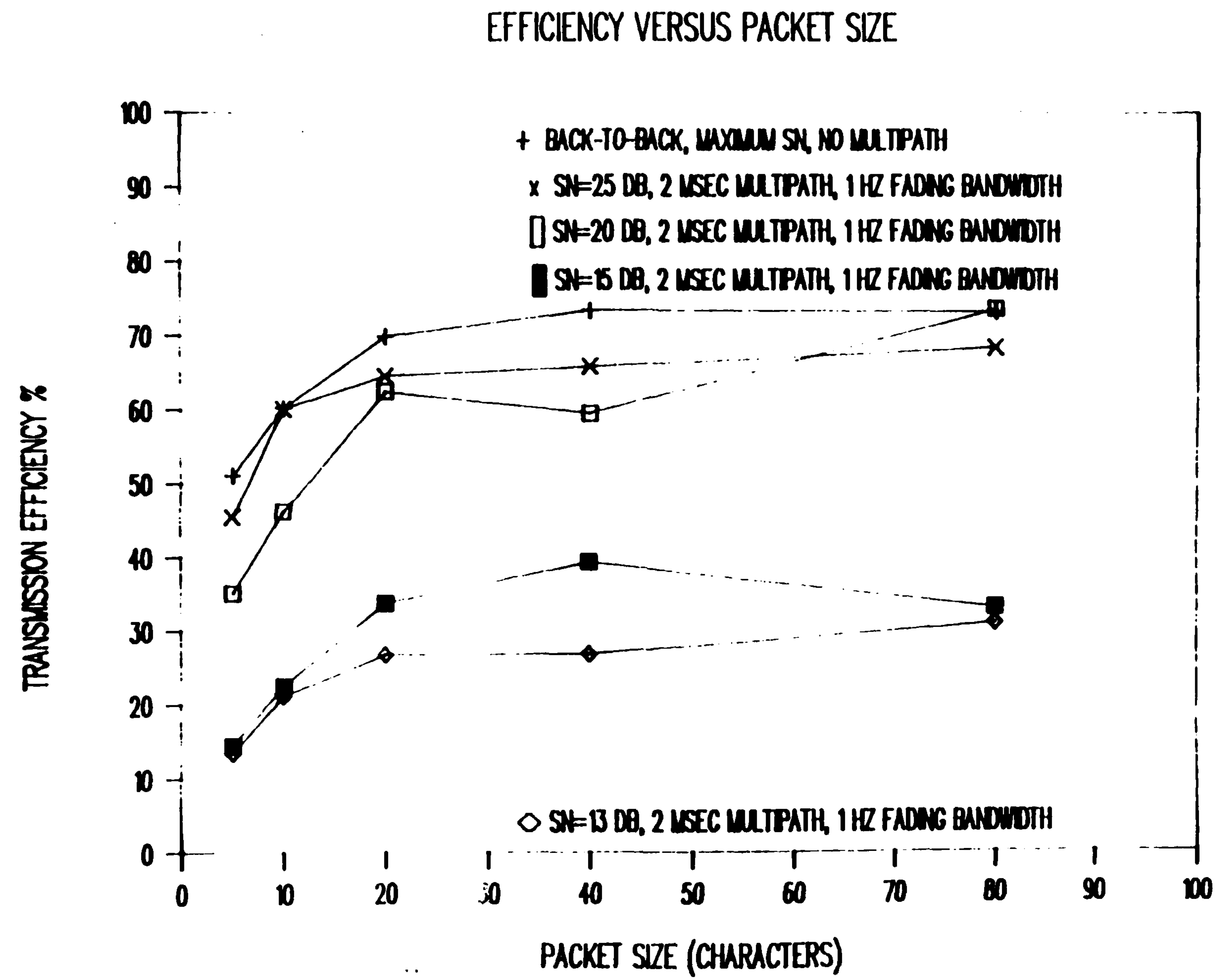


Figure B-83. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message

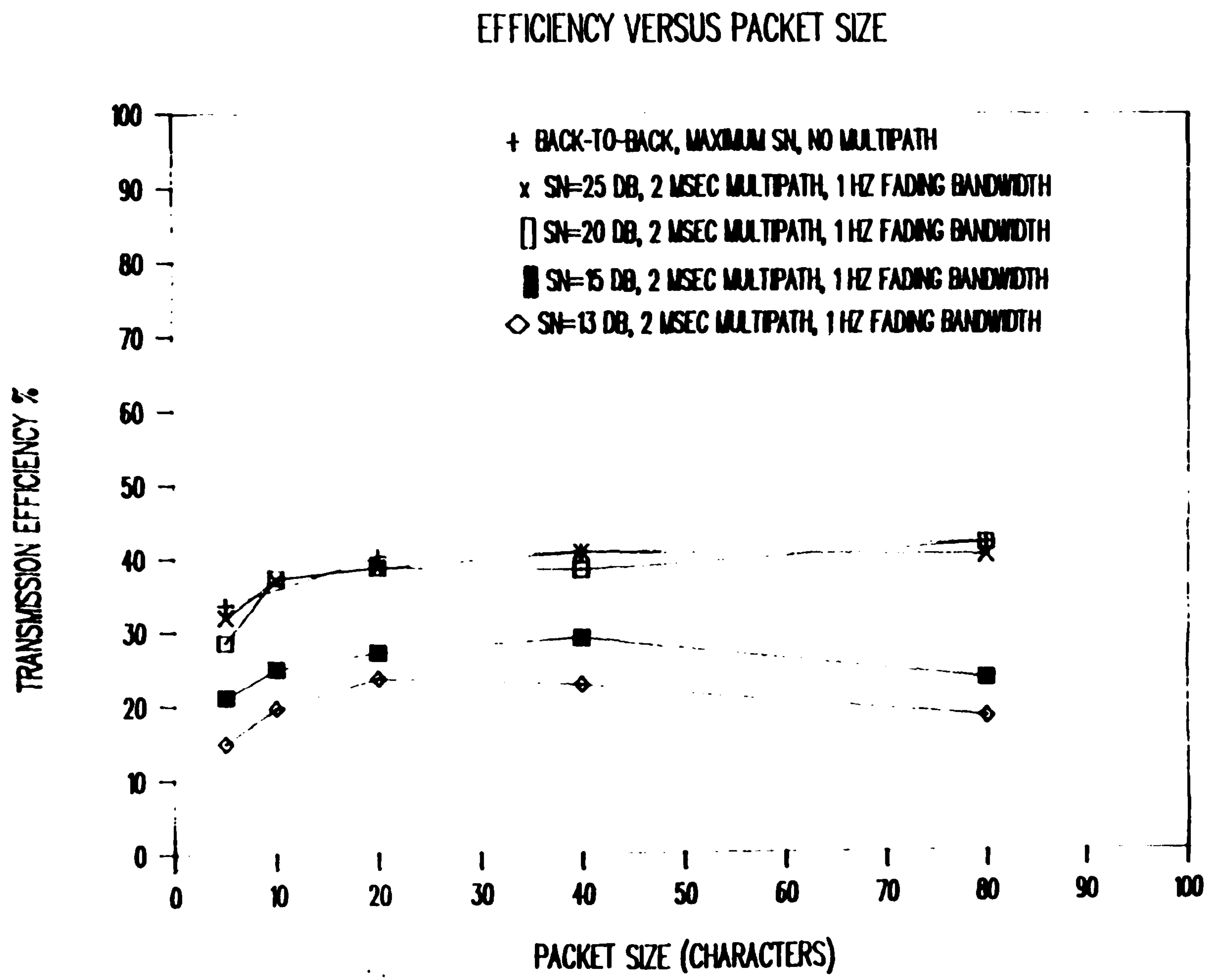


Figure B-84. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message

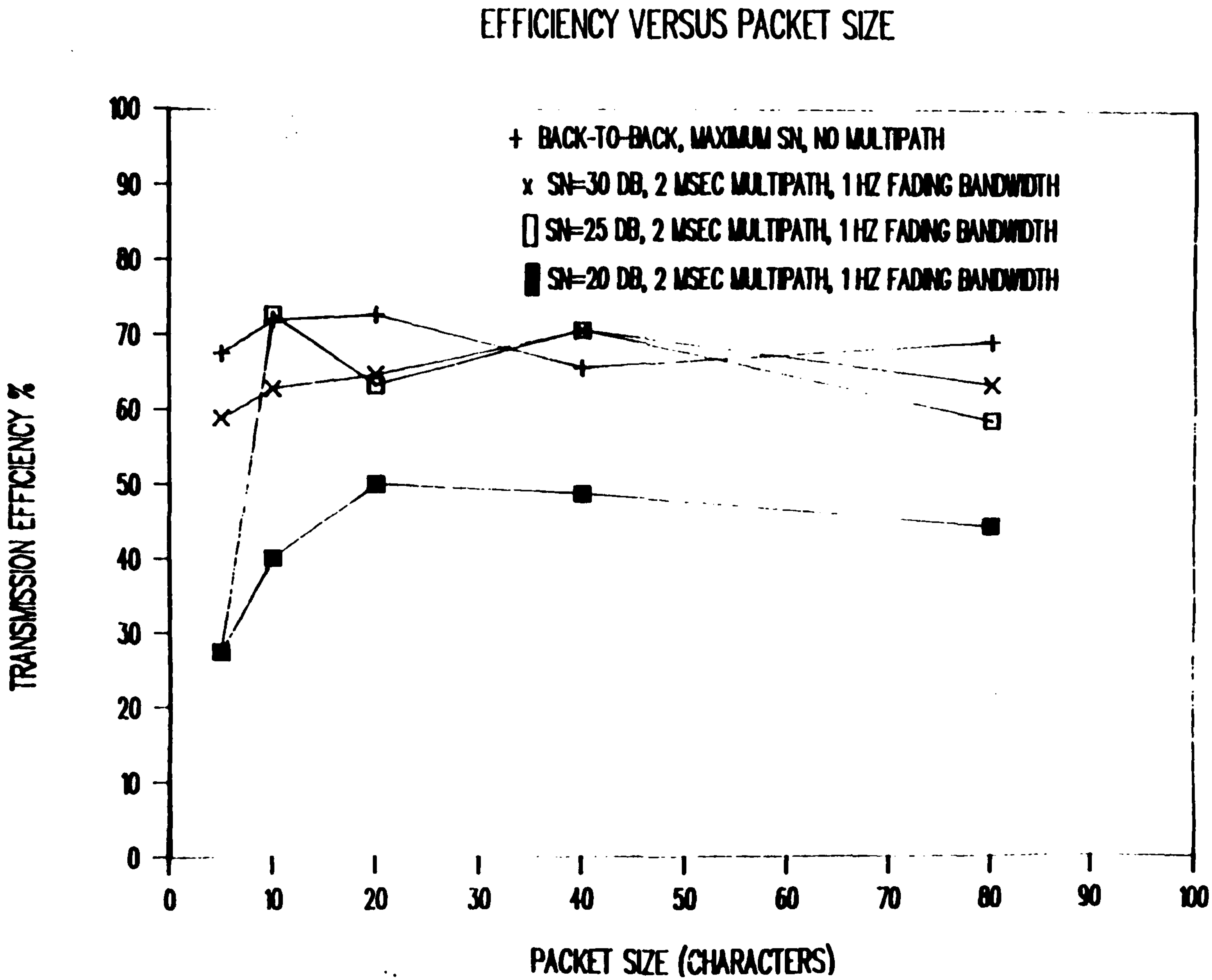


Figure B-85. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message

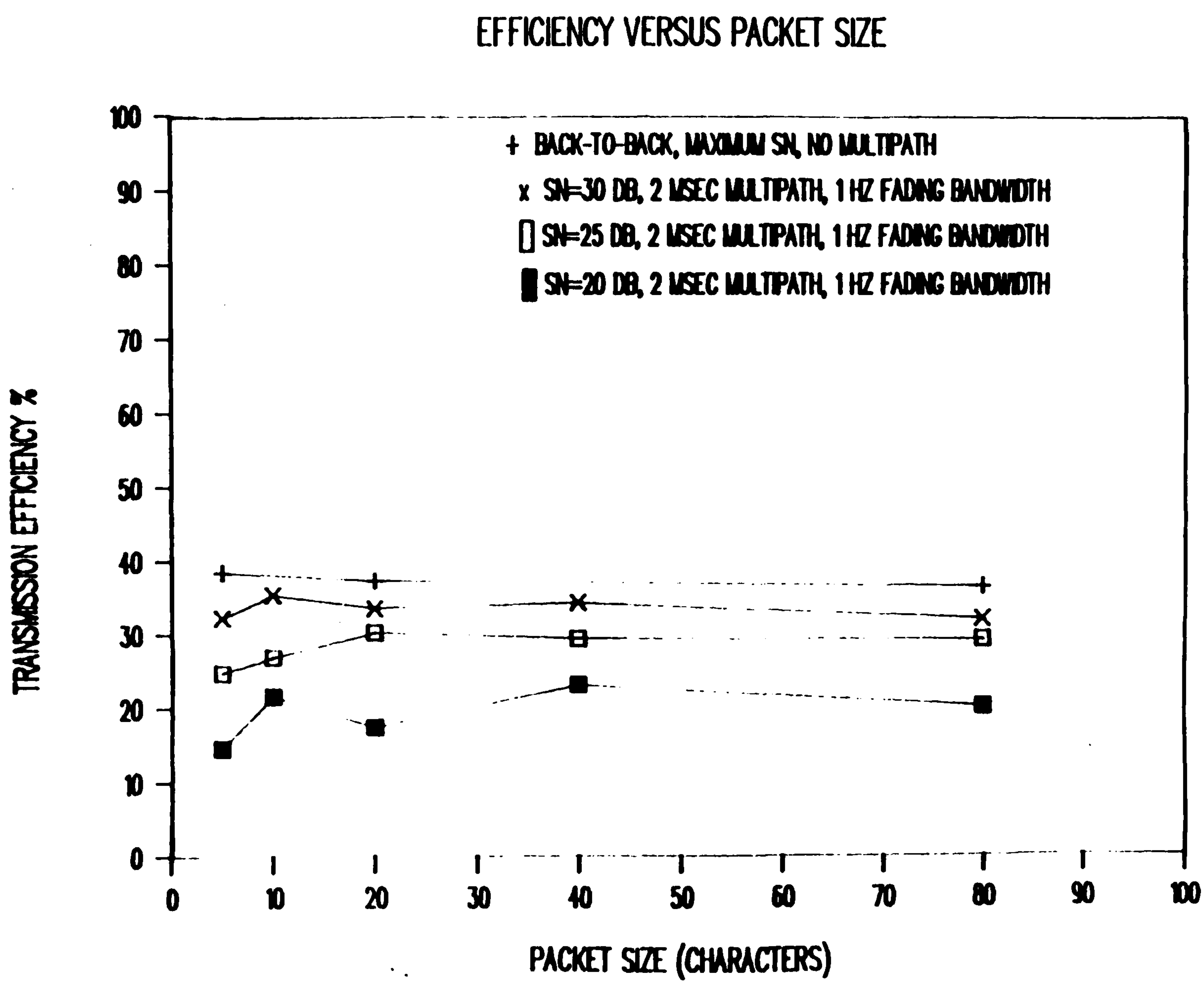


Figure B-86. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous, Medium Message

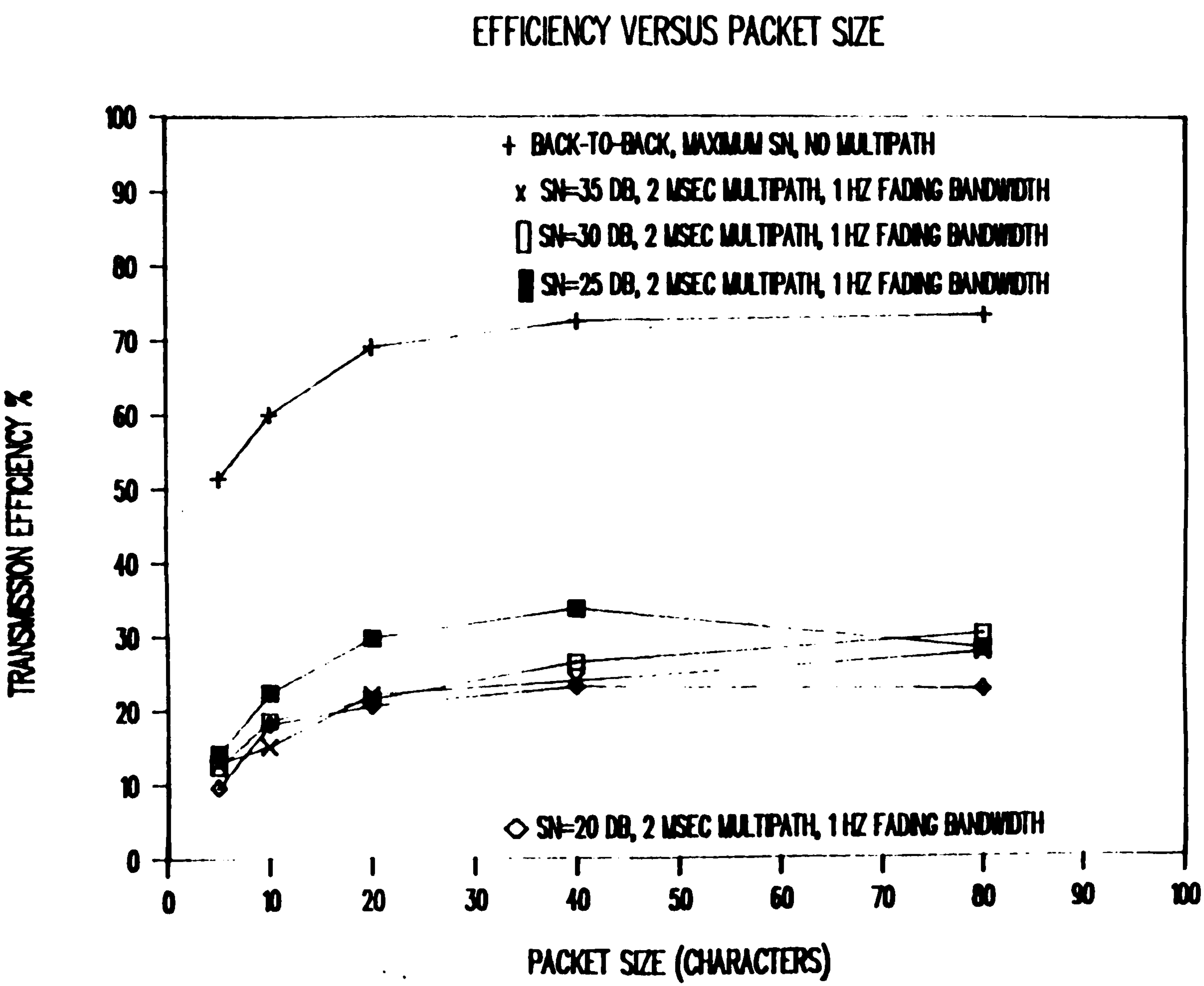


Figure B-87. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message

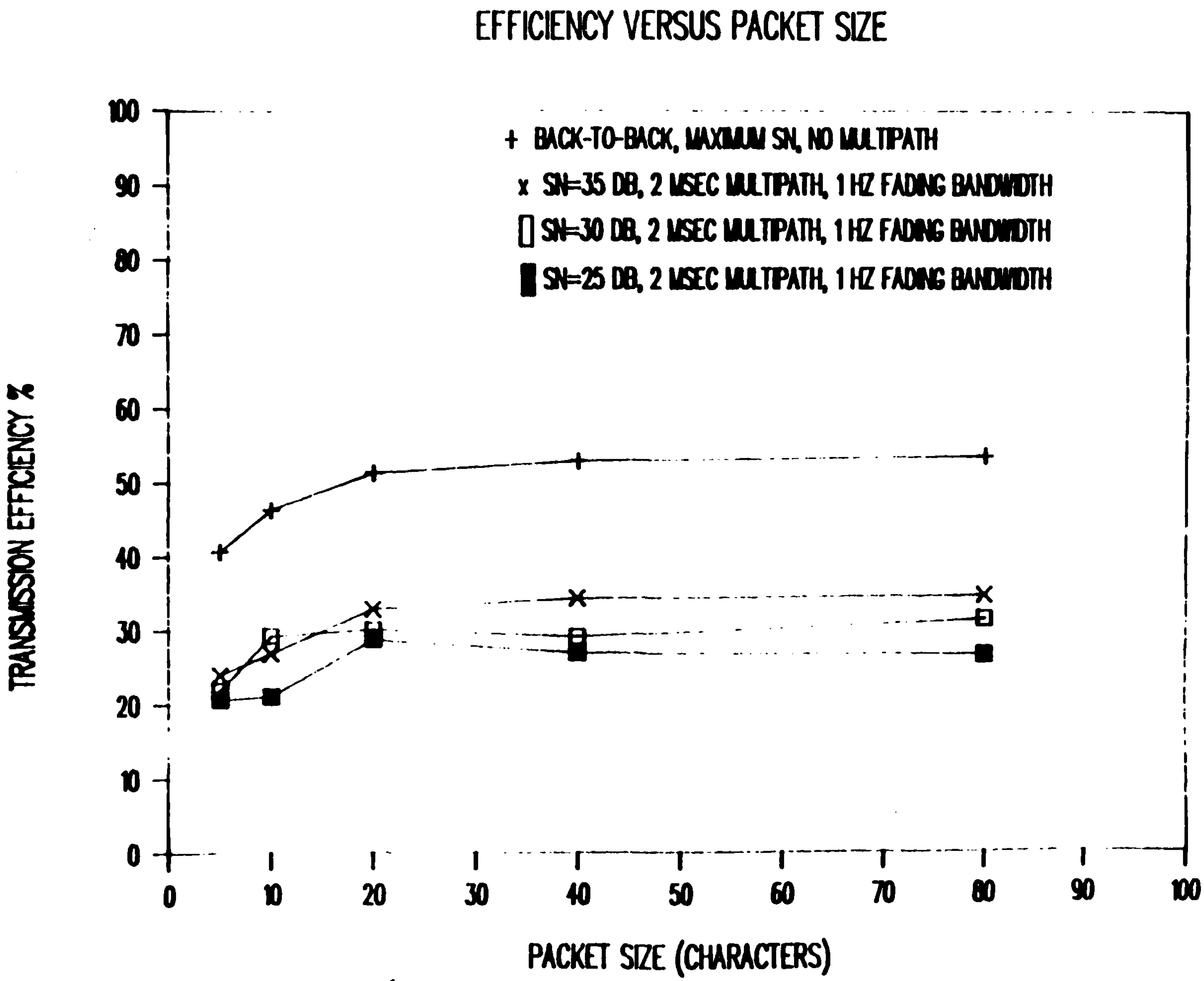


Figure B-88. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous, Medium Message

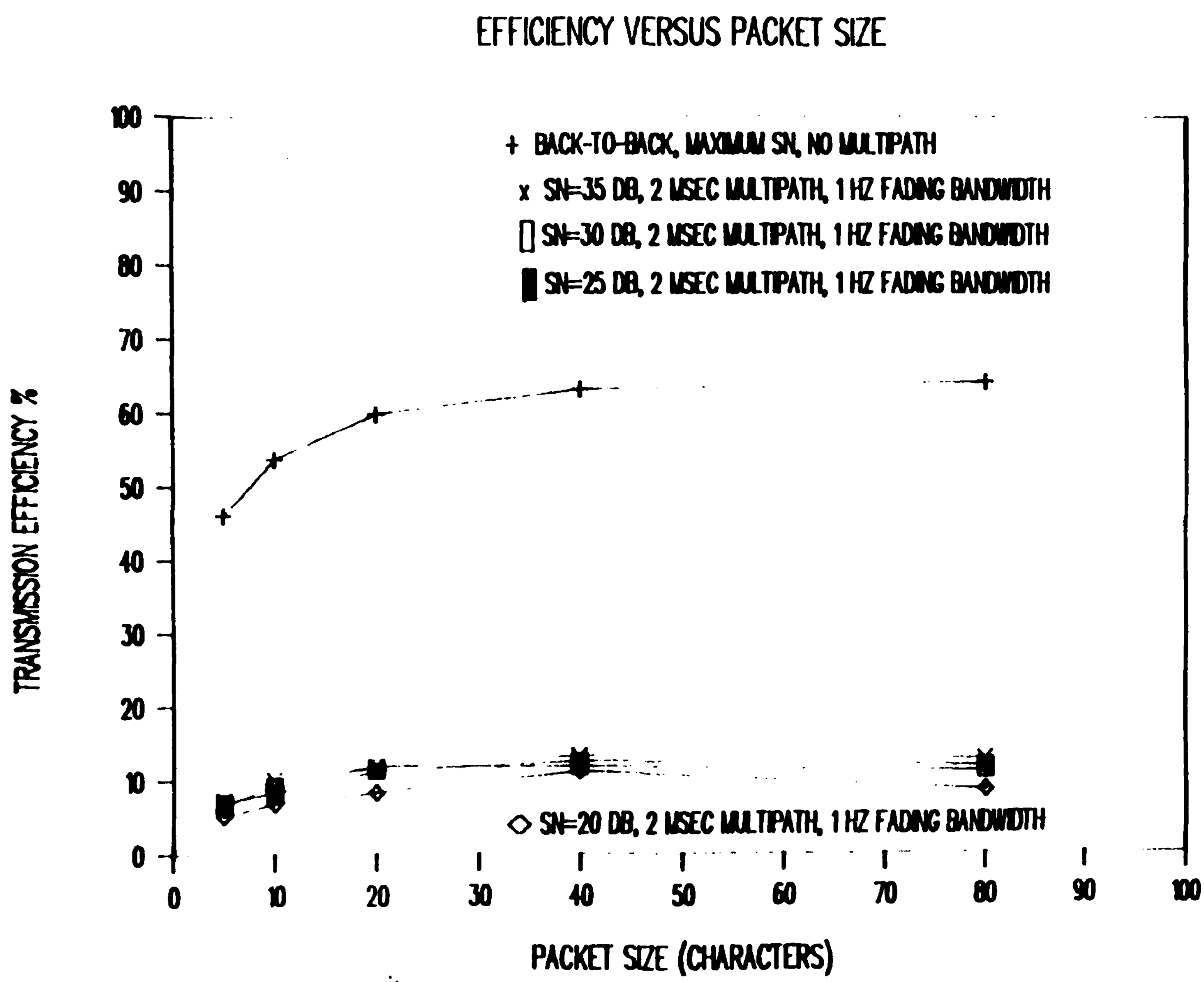


Figure B-89. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous, Medium Message

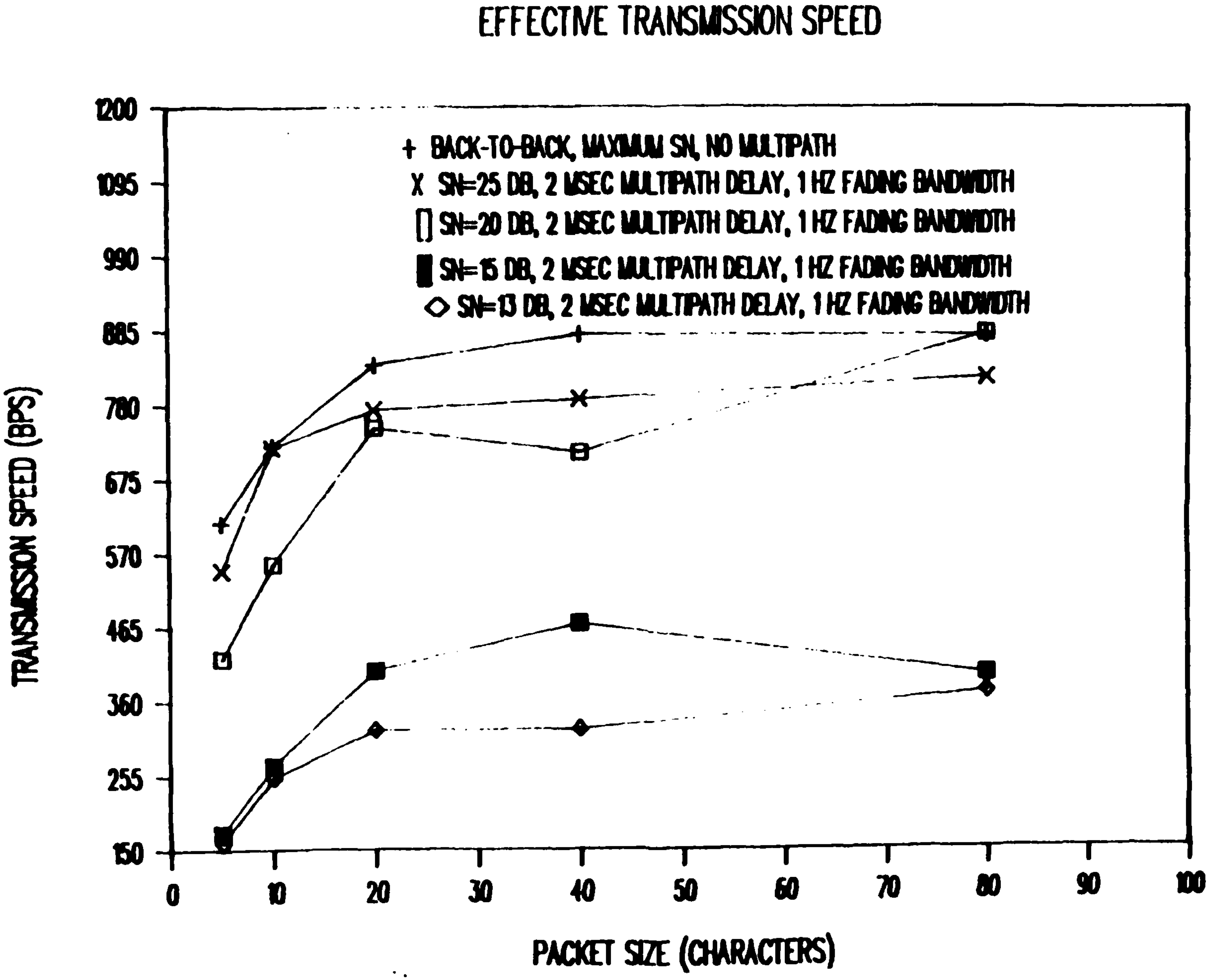


Figure B-90. RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message

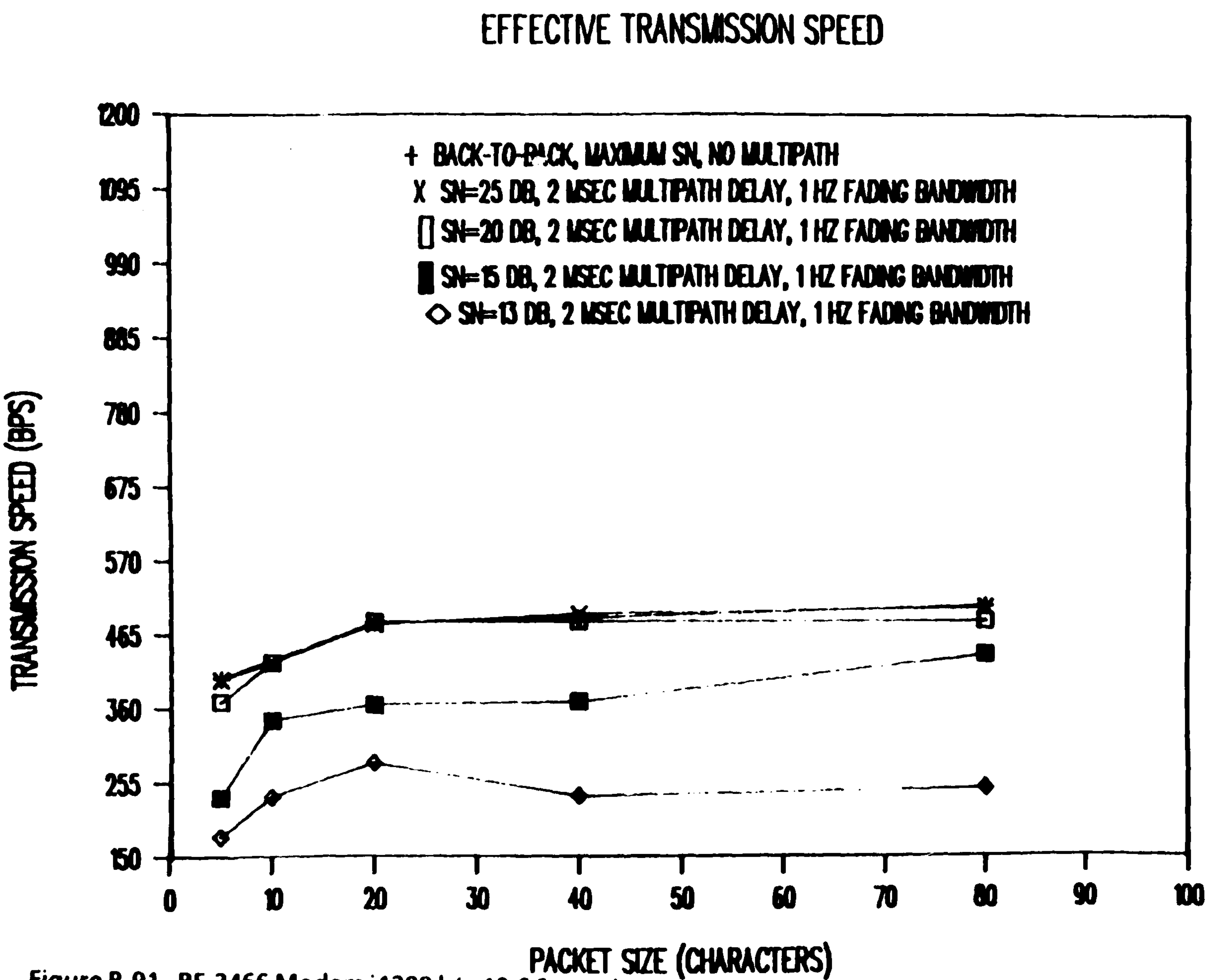


Figure B-91. RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message

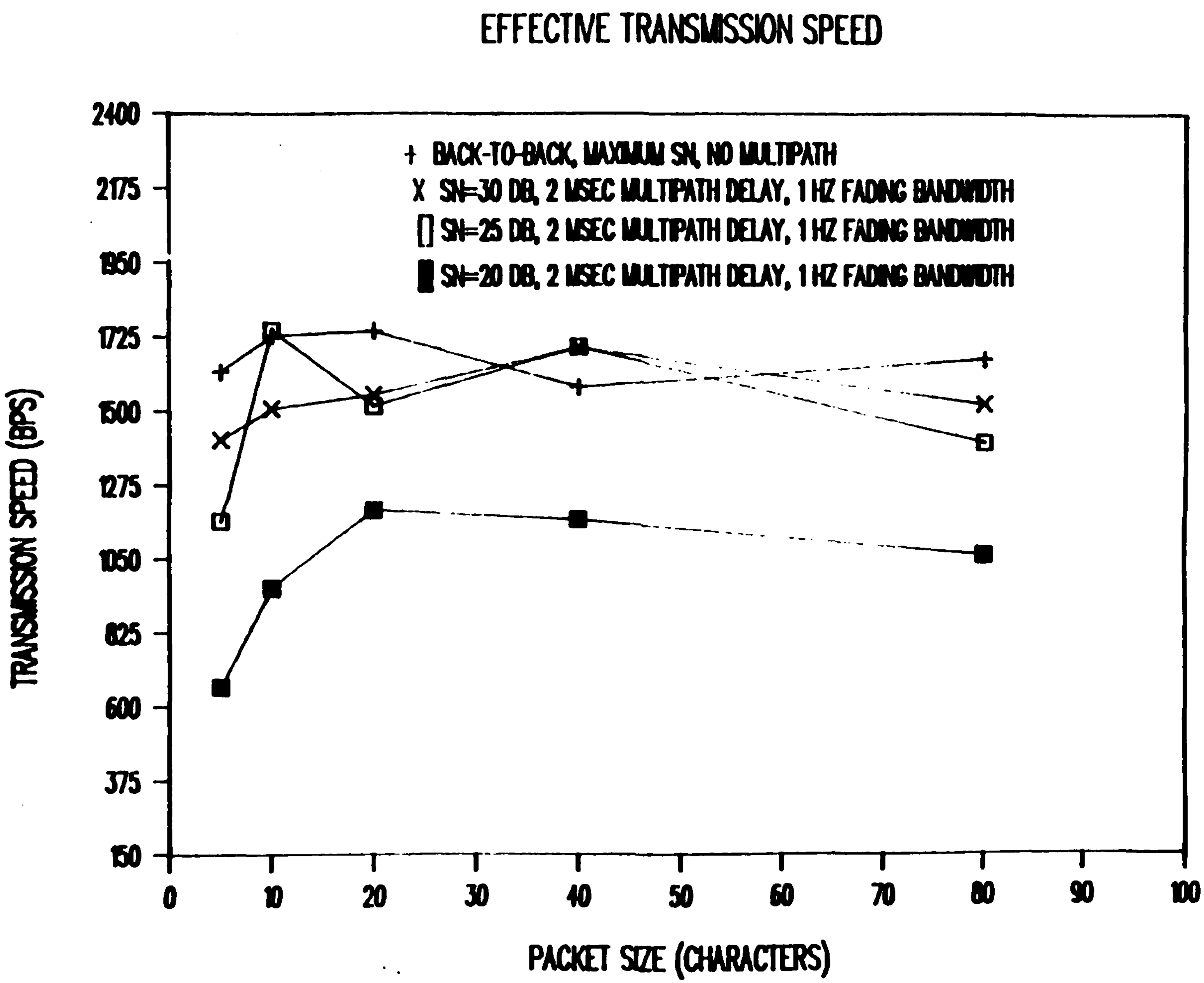


Figure B-92. RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message

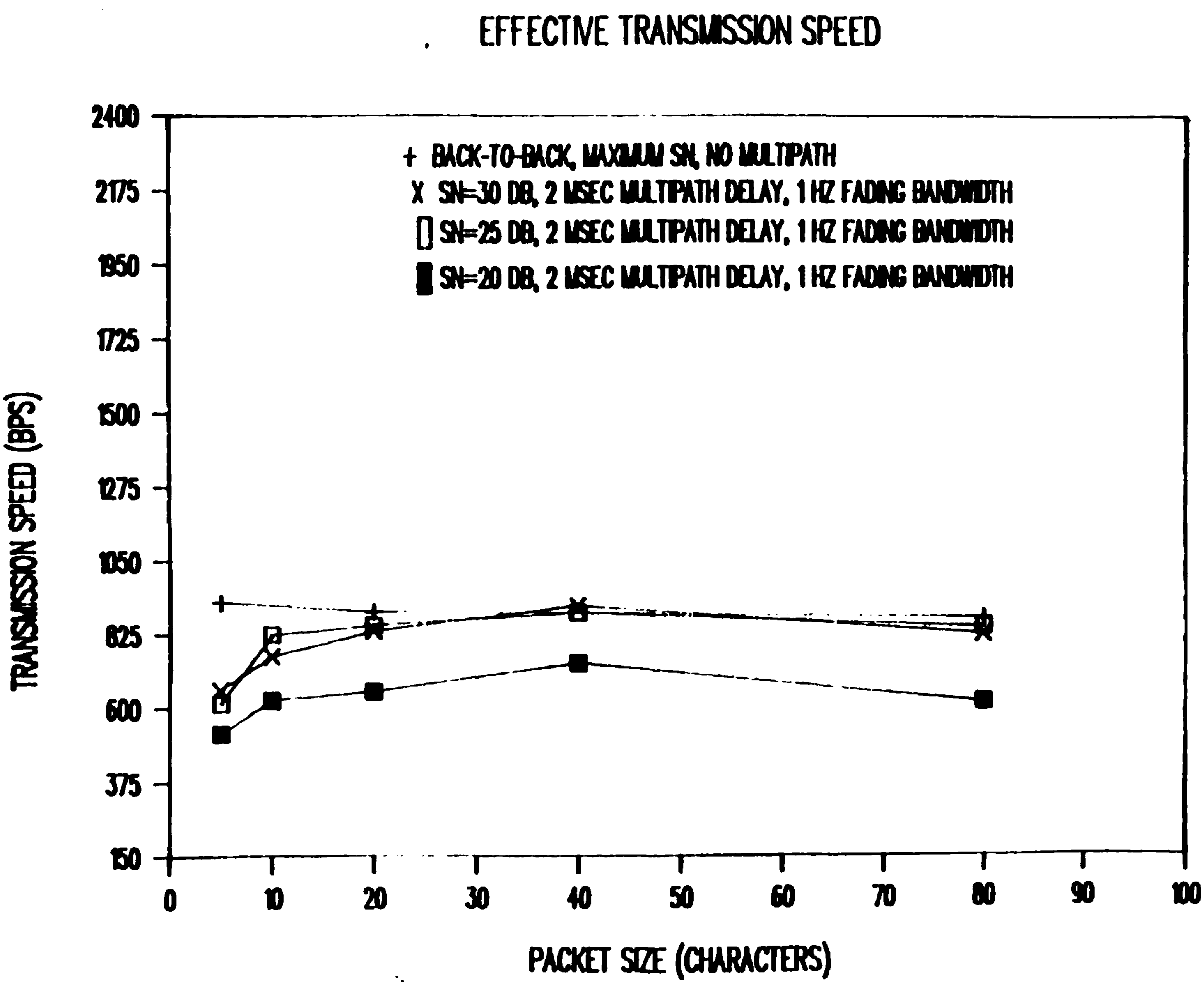


Figure B-93. RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous, Medium Message

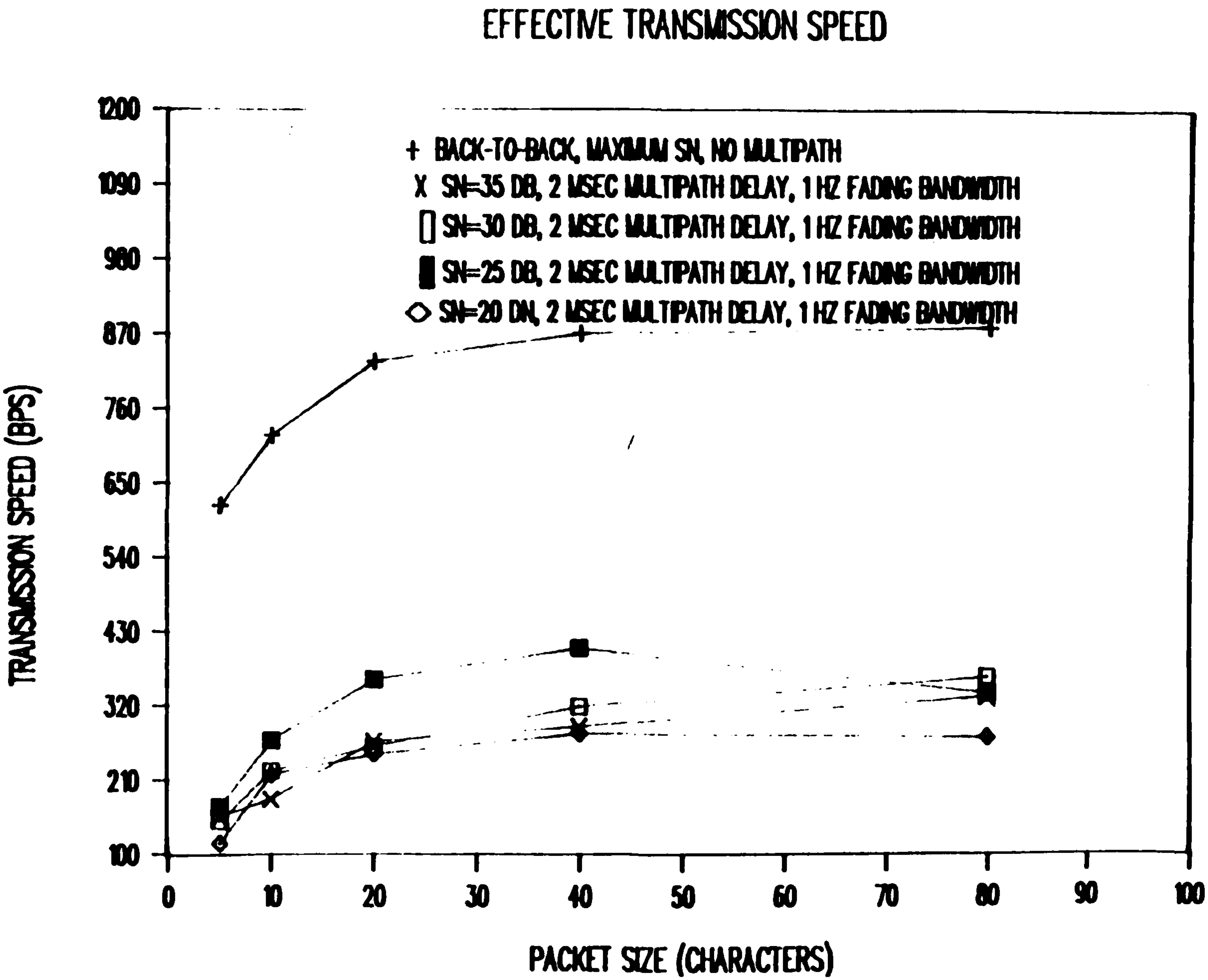


Figure B-94. MD-1061 Modem, 1200 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message

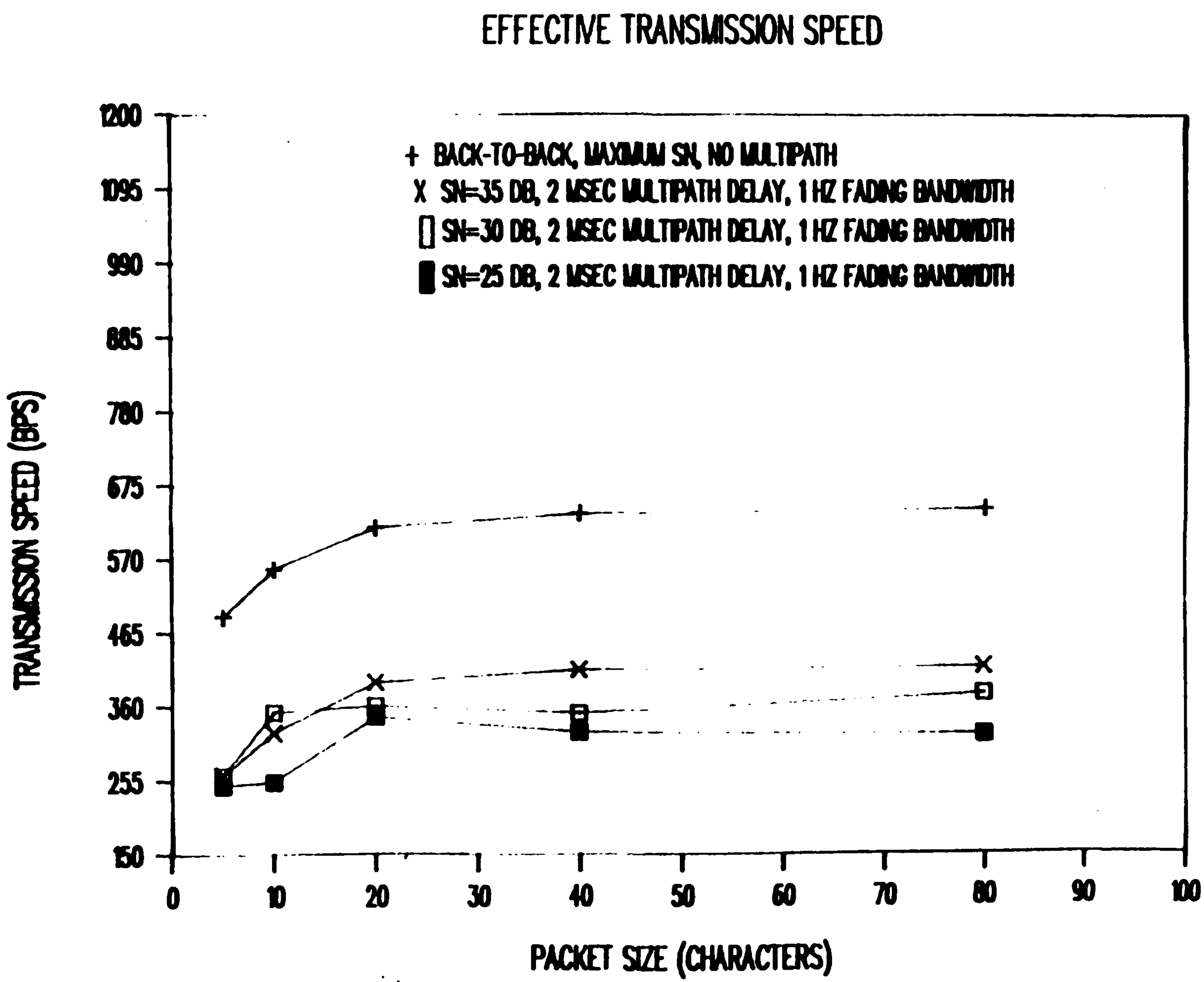


Figure B-95. MD-1061 Modem, 1200 b/s, 6.4 Second Interleaver Delay, Mode I Continuous, Medium Message

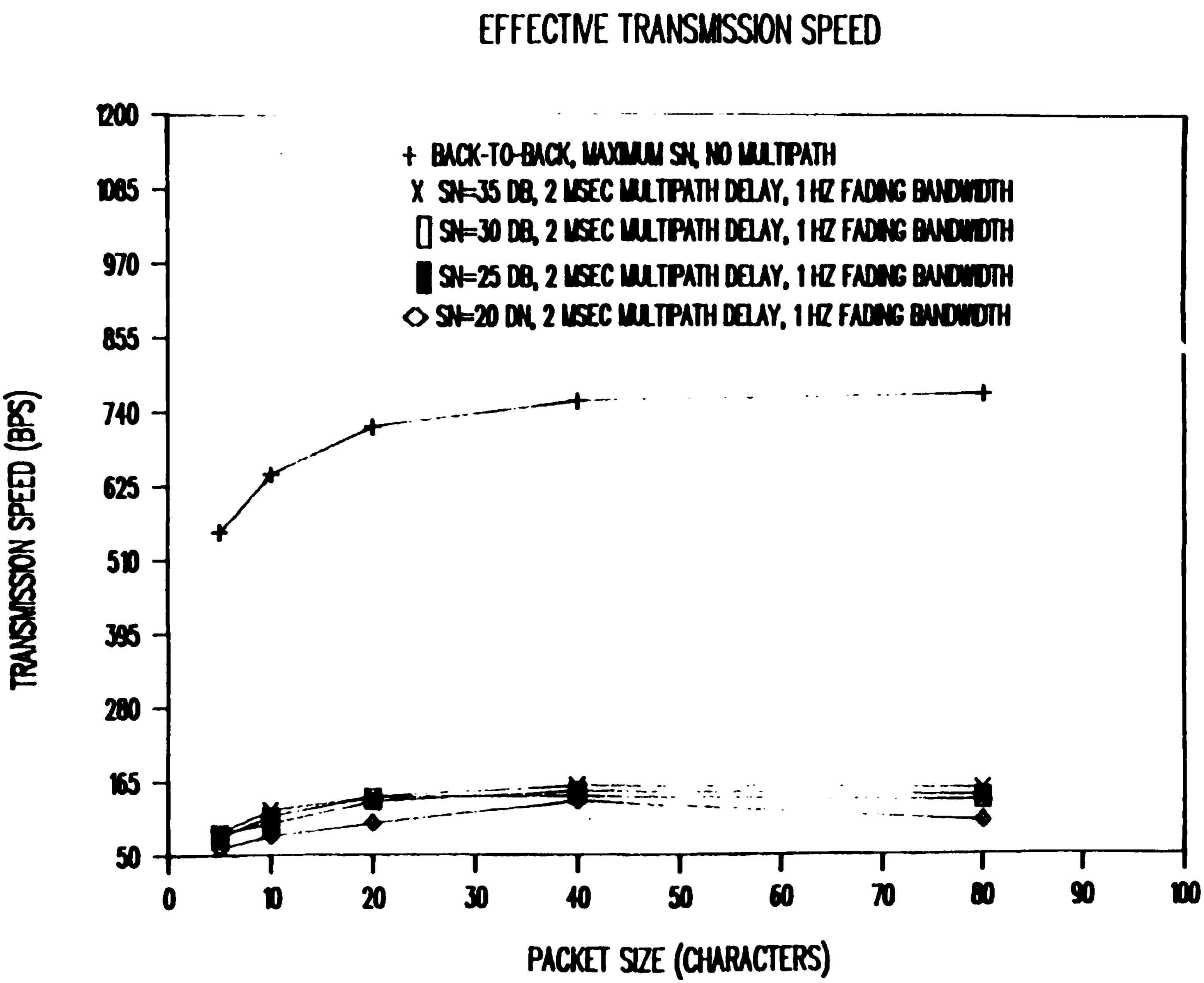


Figure B-96. HSM-1A Modem, 1200 b/s, 3.5 Second Interleaver Delay, Mode I Continuous, Medium Message

Table B-7. Modem Bit Error Rate versus Signal-to-Noise Ratio

Modem	Data Rate (b/s)	Interleaver Delay (sec)	Receiver Modem Serial Number	Average Bit Error Rate per Signal-to-Noise					
				35	30	25	20	15	13
RF-3466	1200	1.7	A0195 C0398			2.2×10^{-5} 1.7×10^{-5}	5.0×10^{-5} 8.0×10^{-5}	1.1×10^{-4} 2.7×10^{-4}	1.6×10^{-4} 2.6×10^{-4}
	1200	12.6	A0195 C0398			2.3×10^{-6} 2.5×10^{-6}	1.4×10^{-5} 1.2×10^{-5}	1.6×10^{-4} 2.9×10^{-4}	7.2×10^{-4} 1.1×10^{-3}
	2400	1.6	A0195 C0398		2.9×10^{-4} 2.2×10^{-4}	4.9×10^{-4} 5.2×10^{-4}	1.7×10^{-3} 2.0×10^{-3}	1.0×10^{-2} 1.4×10^{-2}	
	2400	9.8	A0195 C0398		2.5×10^{-4} 2.1×10^{-4}	3.2×10^{-4} 2.8×10^{-4}	1.2×10^{-3} 1.3×10^{-3}	7.9×10^{-3} 9.4×10^{-3}	1.9×10^{-2} 2.2×10^{-2}
MD-1061	1200	1.6	097 106	4.7×10^{-4} 7.6×10^{-4}	4.33×10^{-4} 9.9×10^{-4}	1.0×10^{-3} 5.4×10^{-4}	1.6×10^{-3} 9.6×10^{-4}		
	1200	6.4	097 106	5.2×10^{-4} 2.2×10^{-4}	2.6×10^{-4} 3.9×10^{-4}	3.9×10^{-4} 4.8×10^{-4}			
	2400	0		BER Test Set would not stay in sync					
HSM-1A	1200	3.5	63604 63601	1.1×10^{-3} 1.5×10^{-3}	BER Test Set would not stay in sync				
	2400	3.5		BER Test Set would not stay in sync					

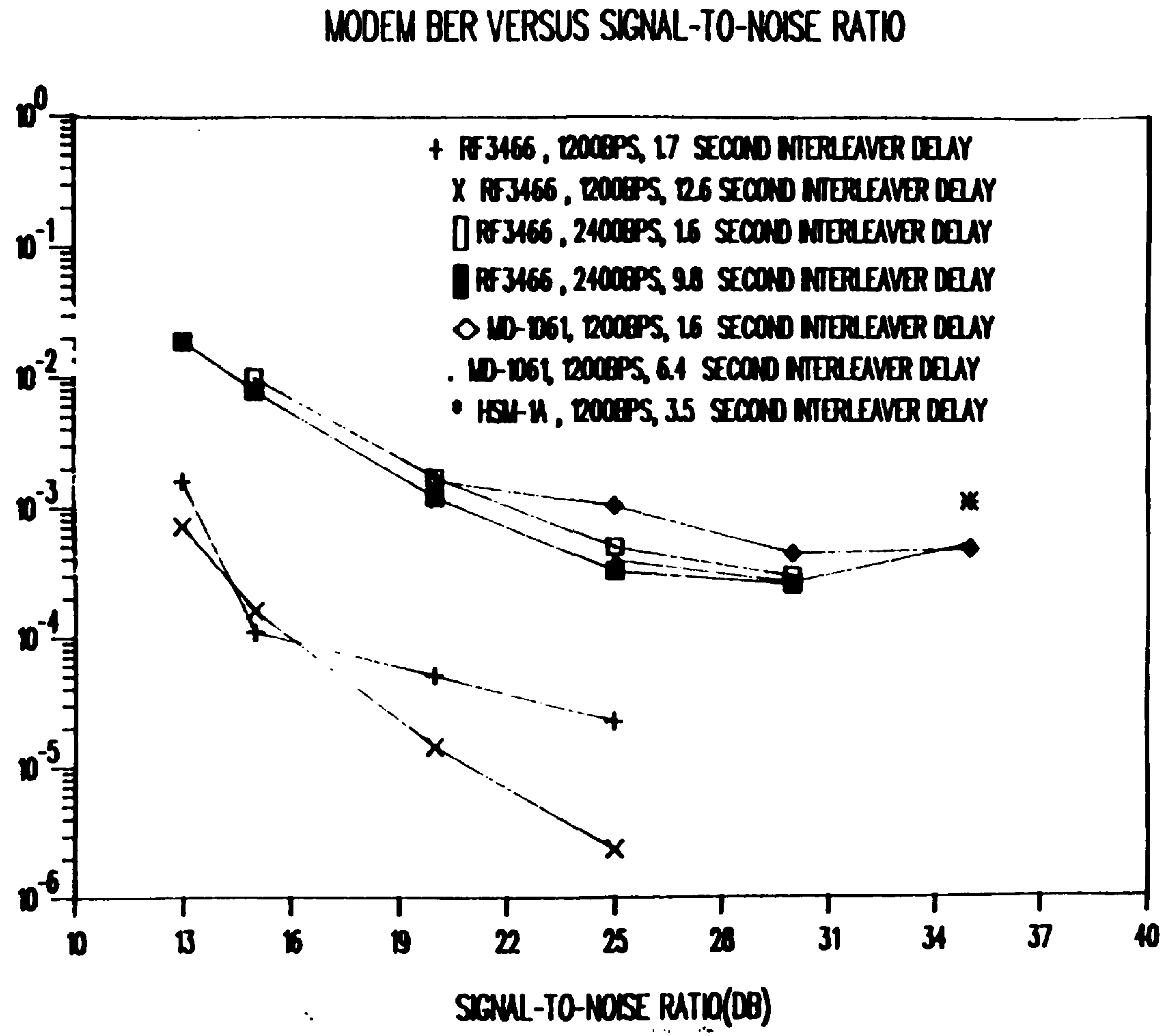


Figure B-97. HF Modem BER (vs) SNR

Section III - Phase III, Over-the-Air Tesing

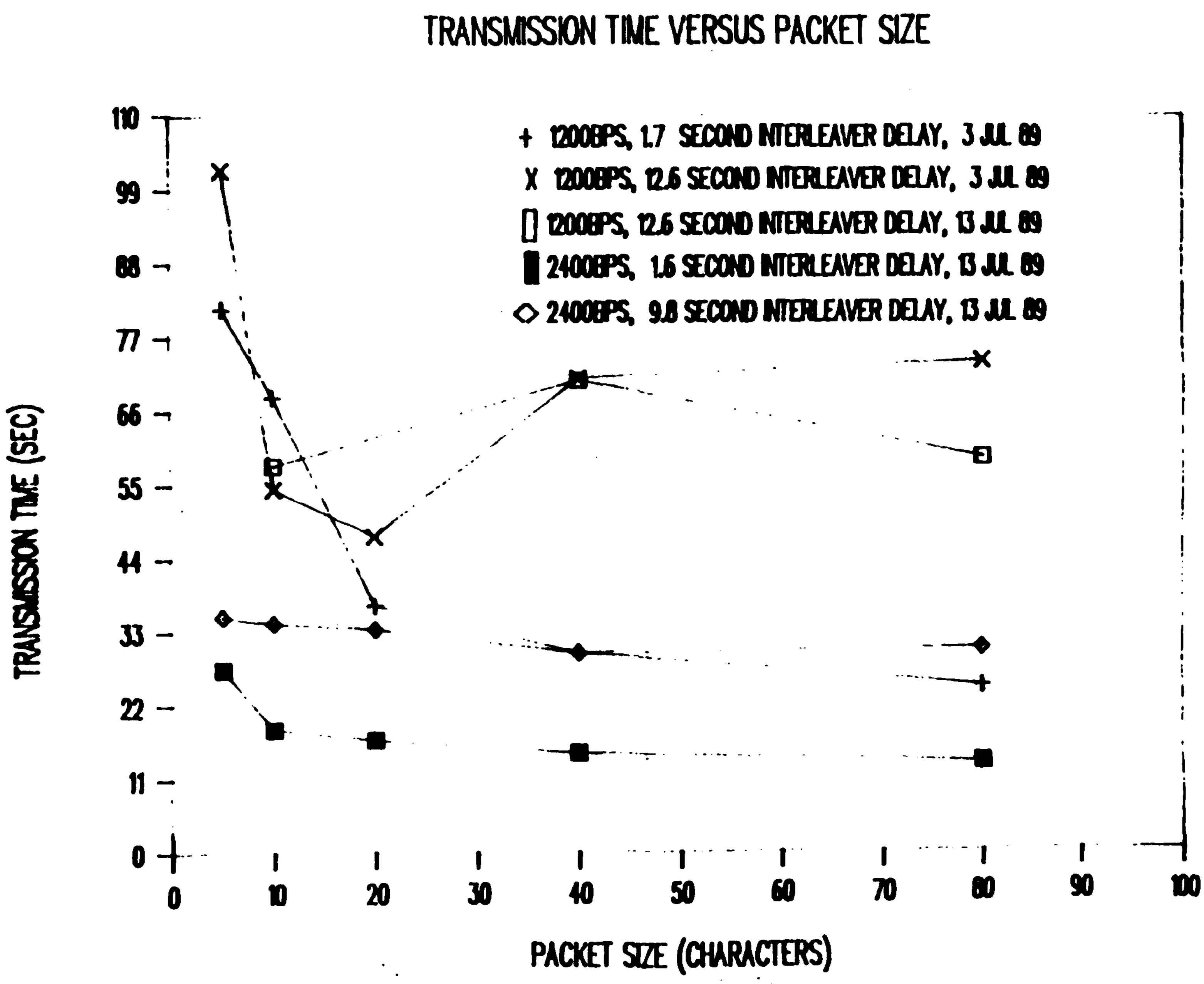


Figure B-98. Over-the-Air, RF-3466 Modem, Medium Message

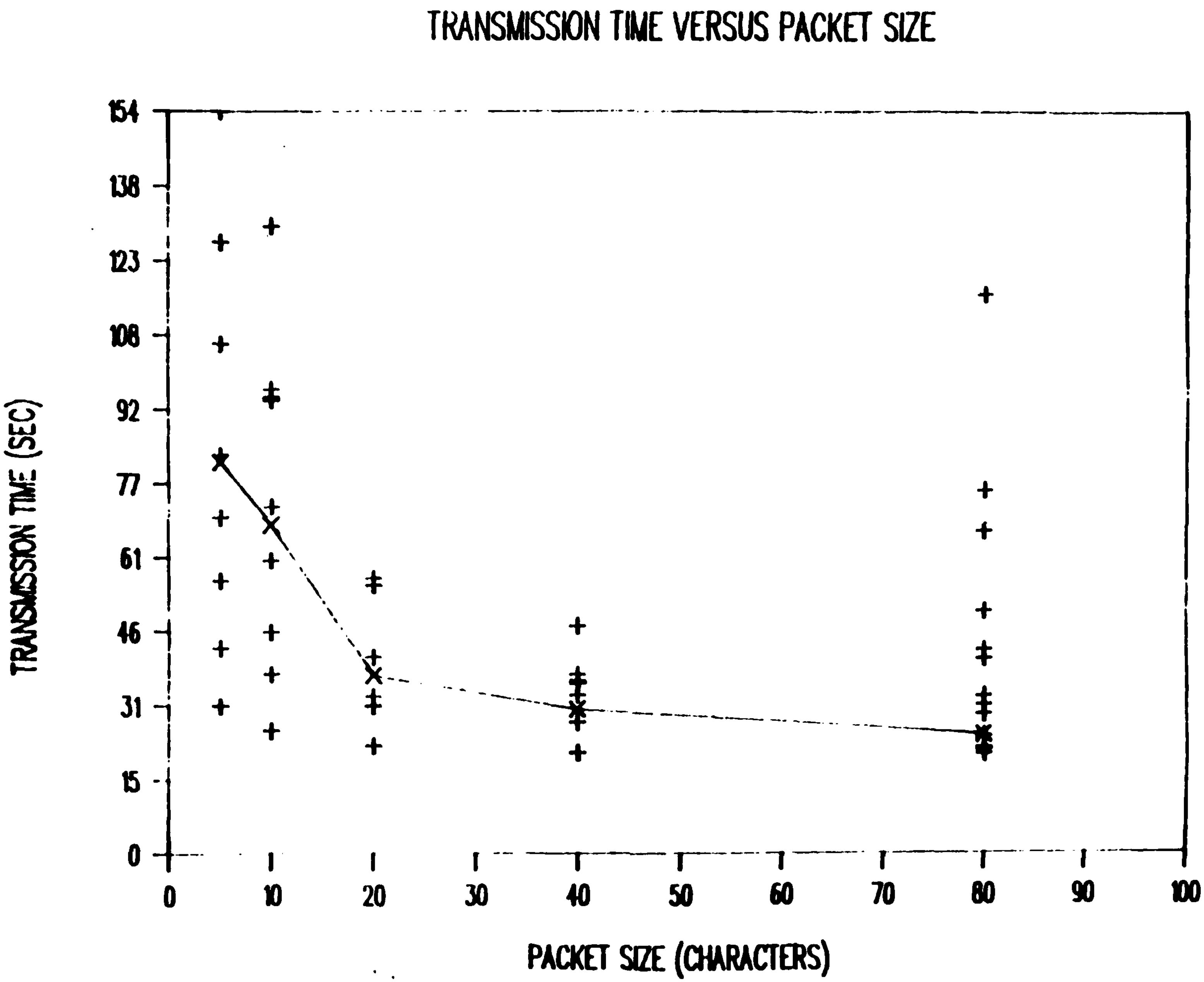


Figure B-99. Over-the-Air, RF-3466 Modem, 1200 b/s, 1.7 Second Interleaver Delay, Mode I Continuous, Medium Message, 3 Jul 89

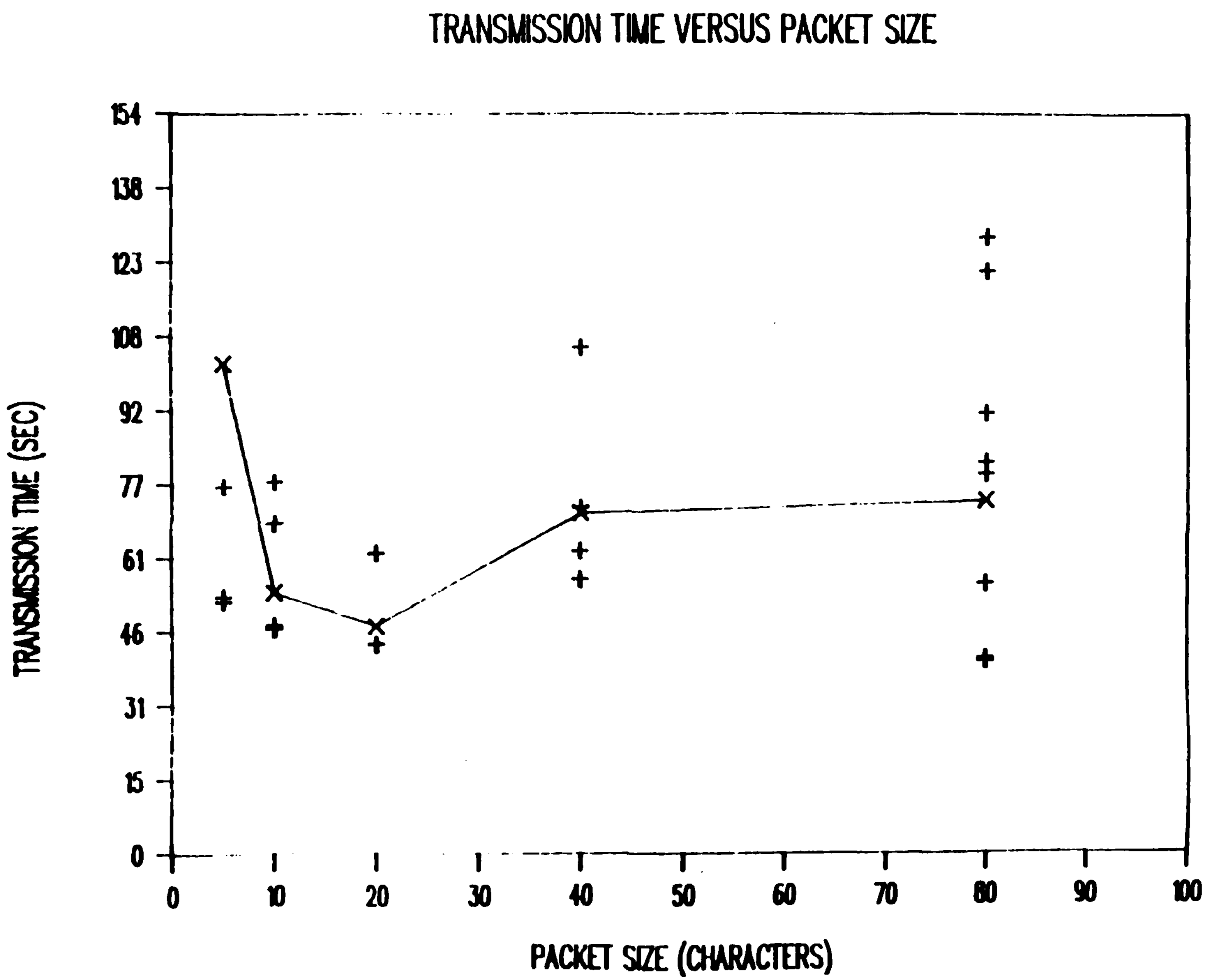


Figure B-100. Over-the-Air, RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message, 3 Jul 89

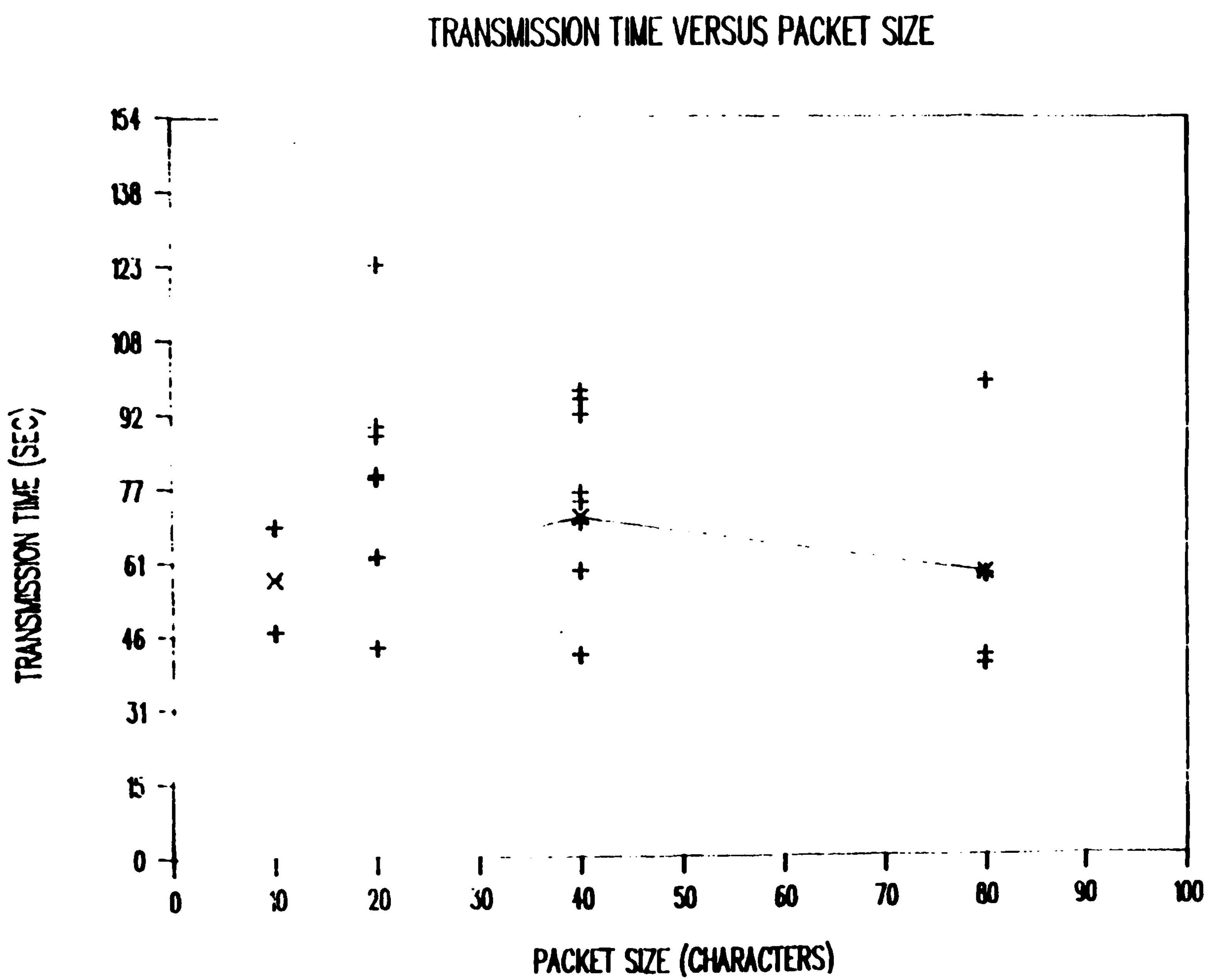


Figure B-101. Over-the-Air, RF-3466 Modem, 1200 b/s, 12.6 Second Interleaver Delay, Mode I Continuous, Medium Message, 13 Jul 89

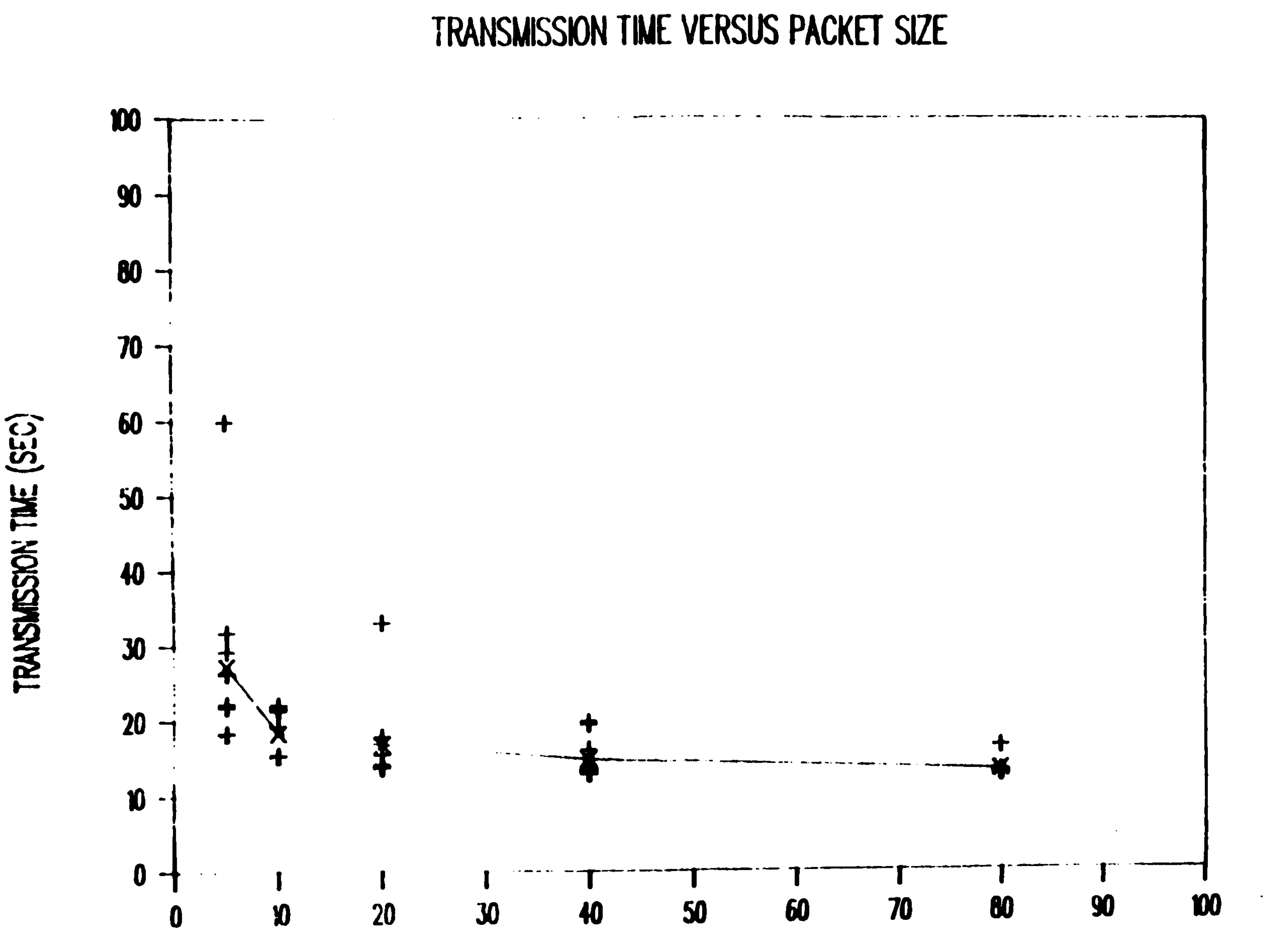


Figure B-102. Over-the-Air, RF-3466 Modem, 2400 b/s, 1.6 Second Interleaver Delay, Mode I Continuous, Medium Message, 13 Jul 89

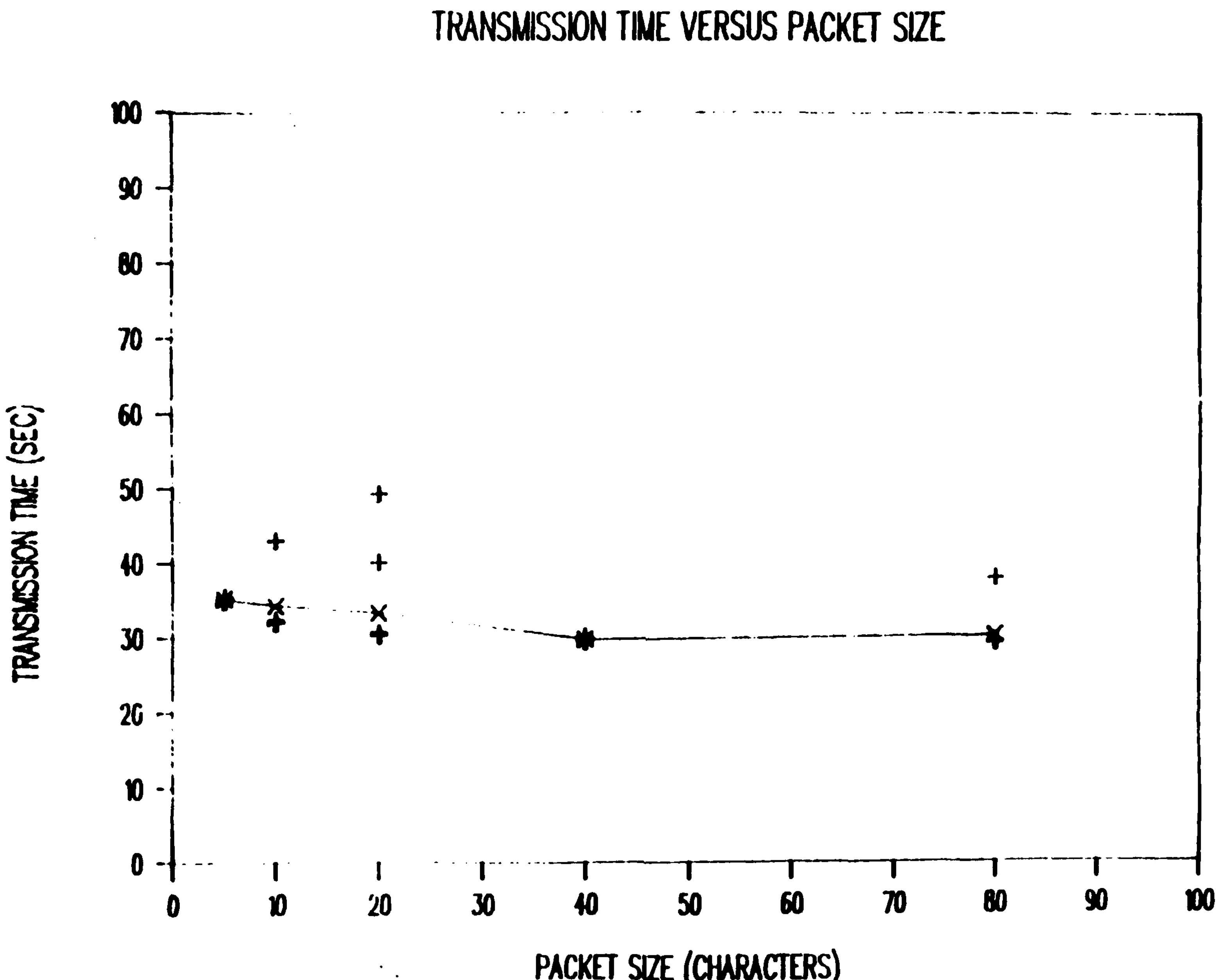


Figure B-103. Over-the-Air, RF-3466 Modem, 2400 b/s, 9.8 Second Interleaver Delay, Mode I Continuous, Medium Message, 13 Jul 89

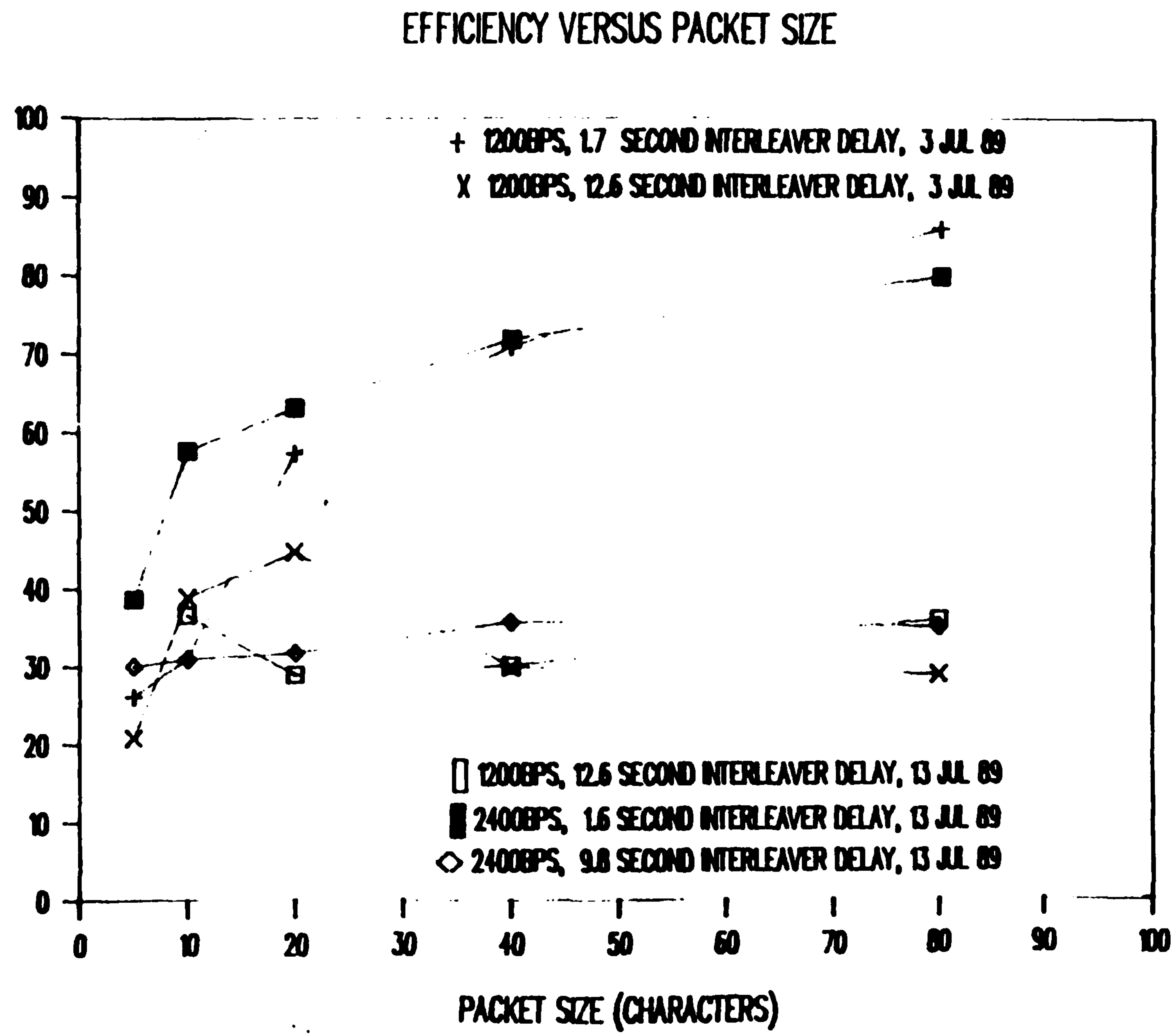


Figure B-104. Over-the-Air, RF-3466 Modem, Medium Message

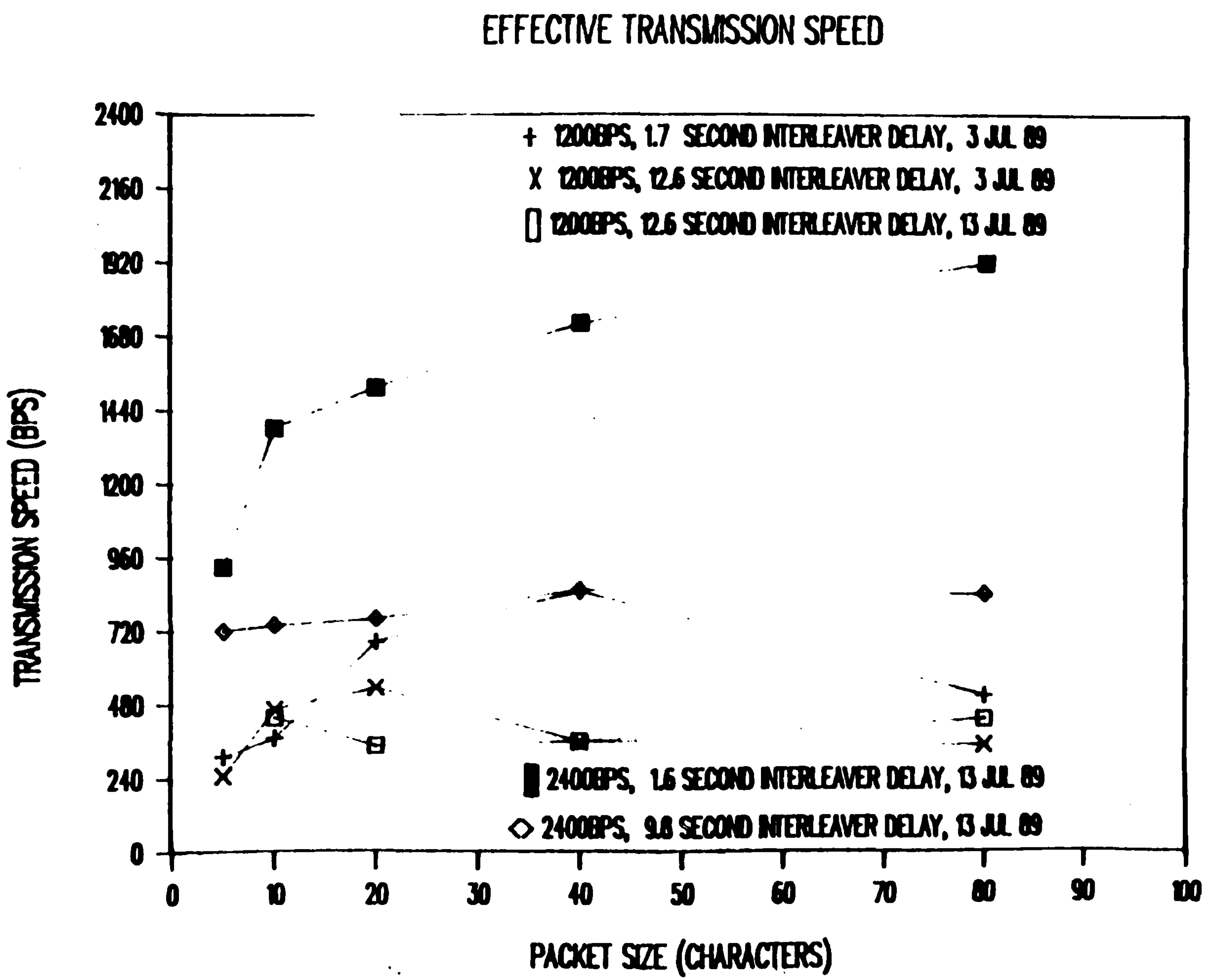


Figure B-105. Over-the-Air, RF-3466 Modem, Medium Message

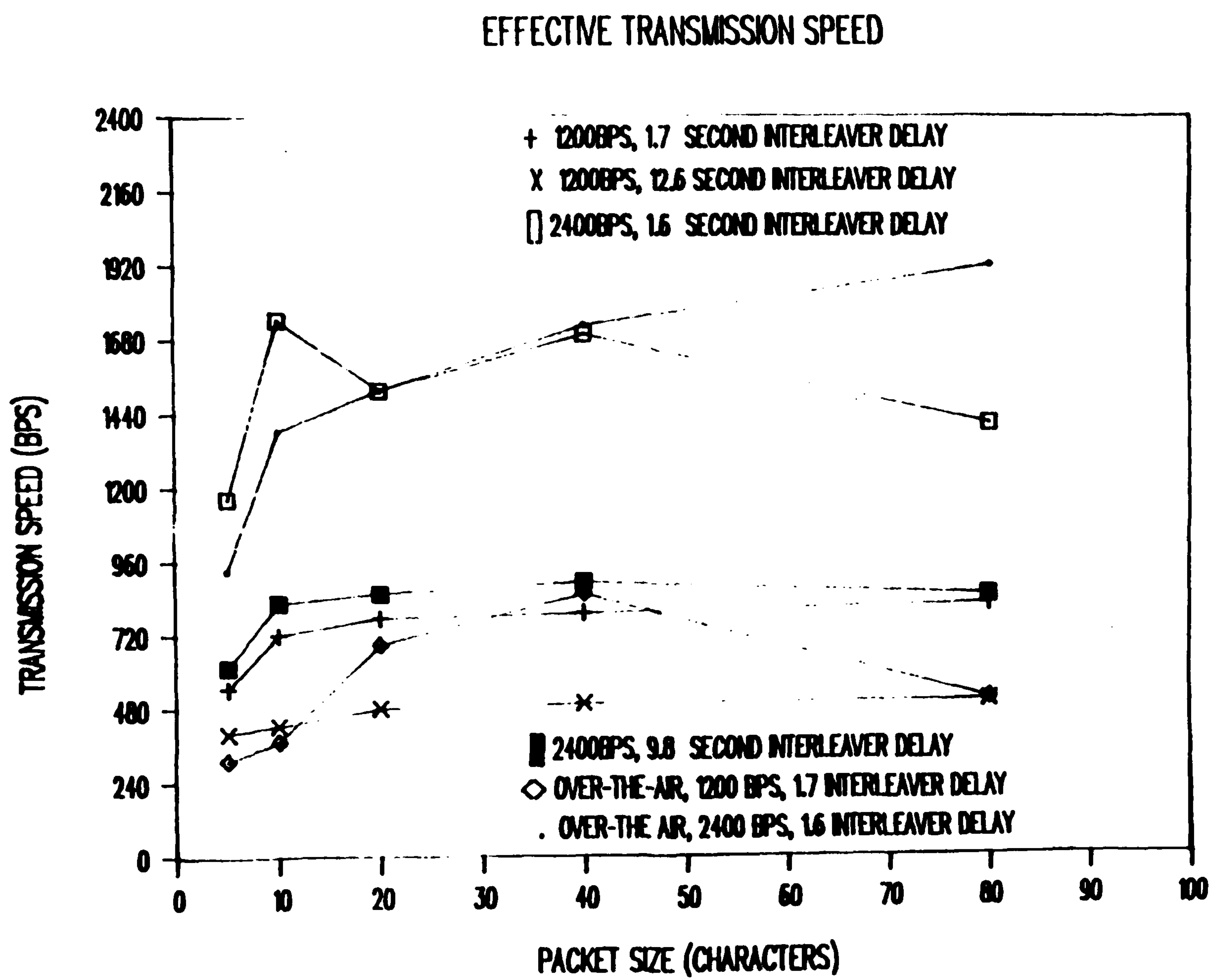


Figure B-106. Effective Transmission Speed, RF-3466 Modem, SN = 25 DB, Medium Message

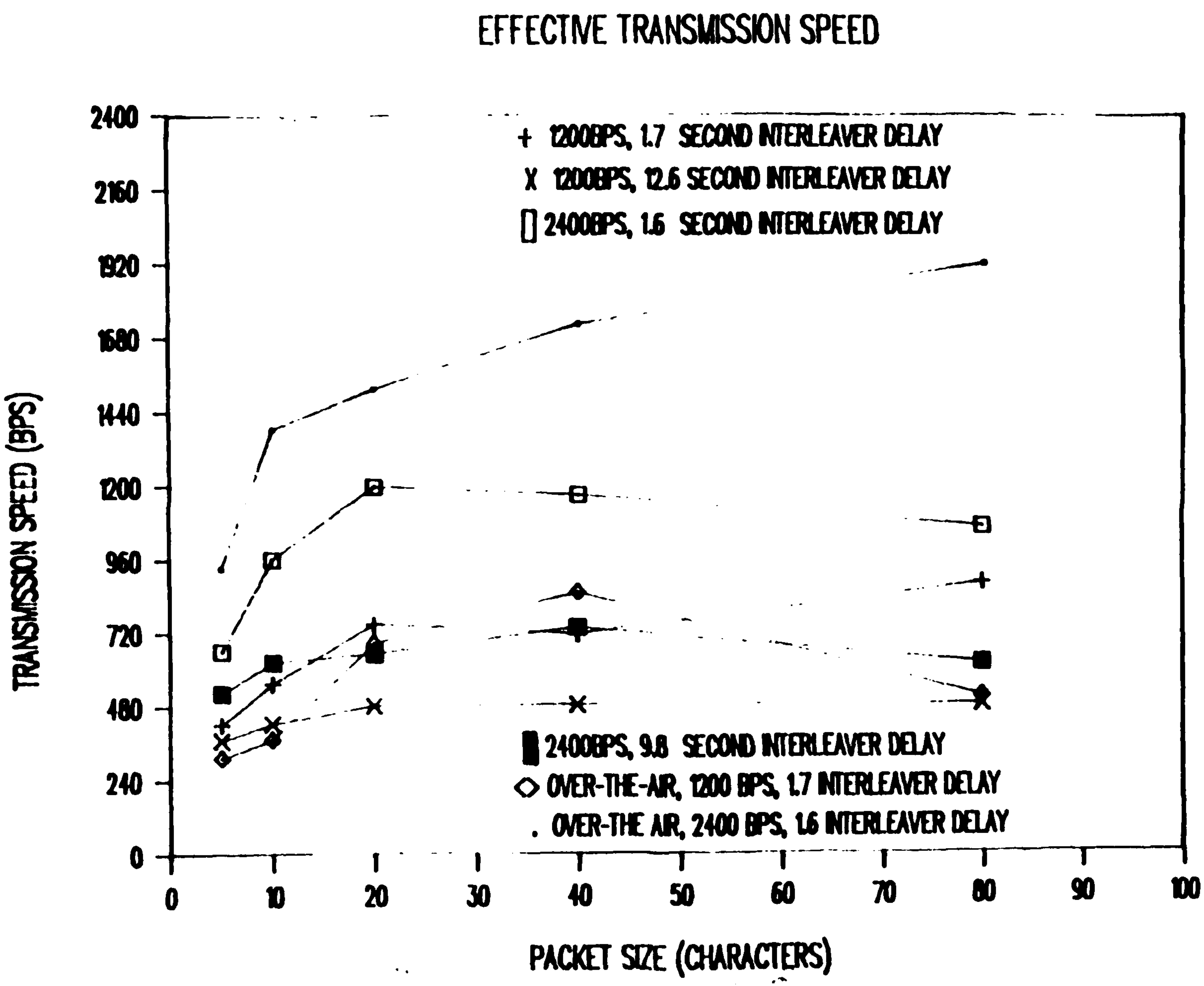


Figure B-107. Effective Transmission Speed, RF-3466 Modem, SN = 20 DB, Medium Message

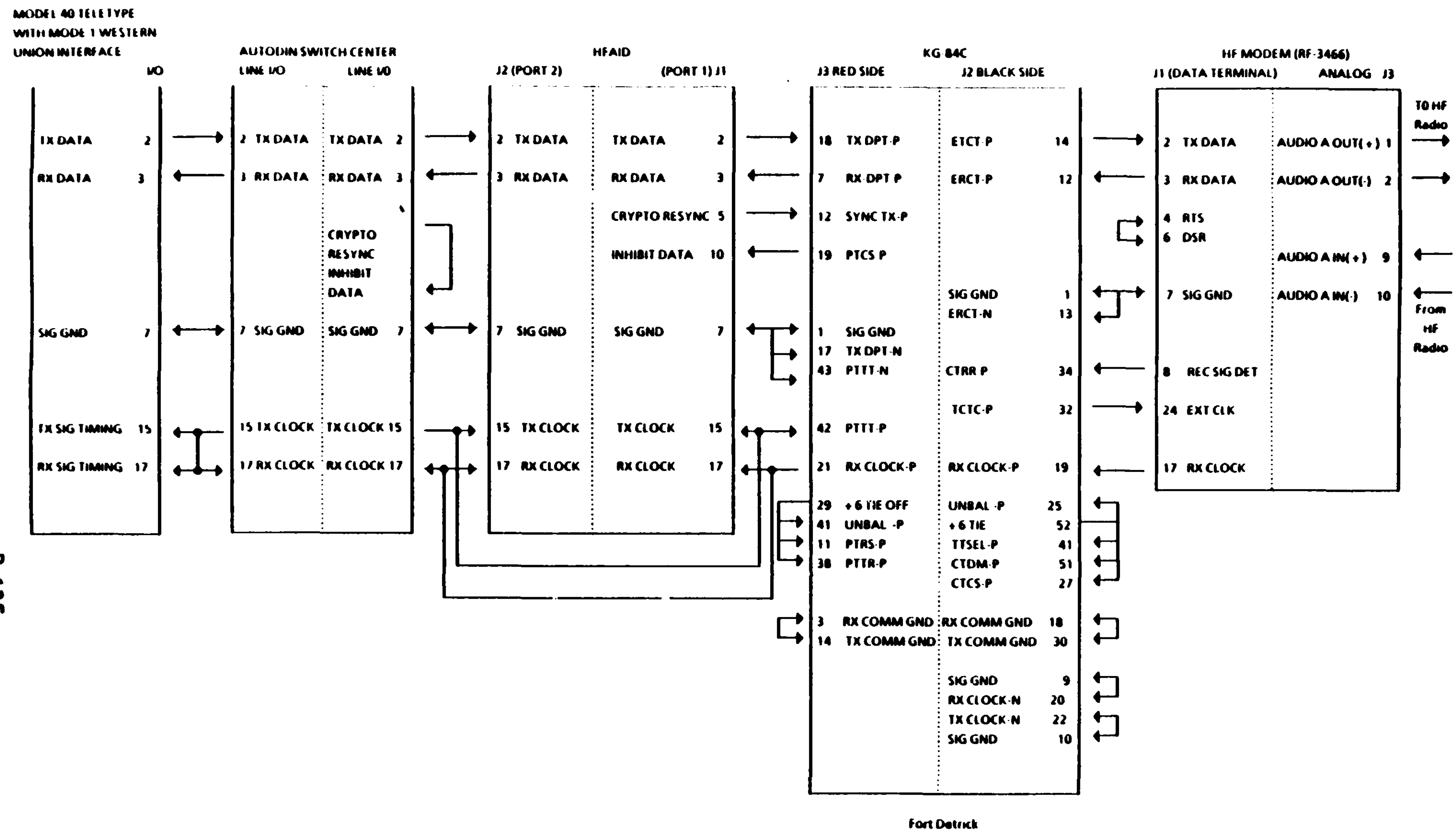
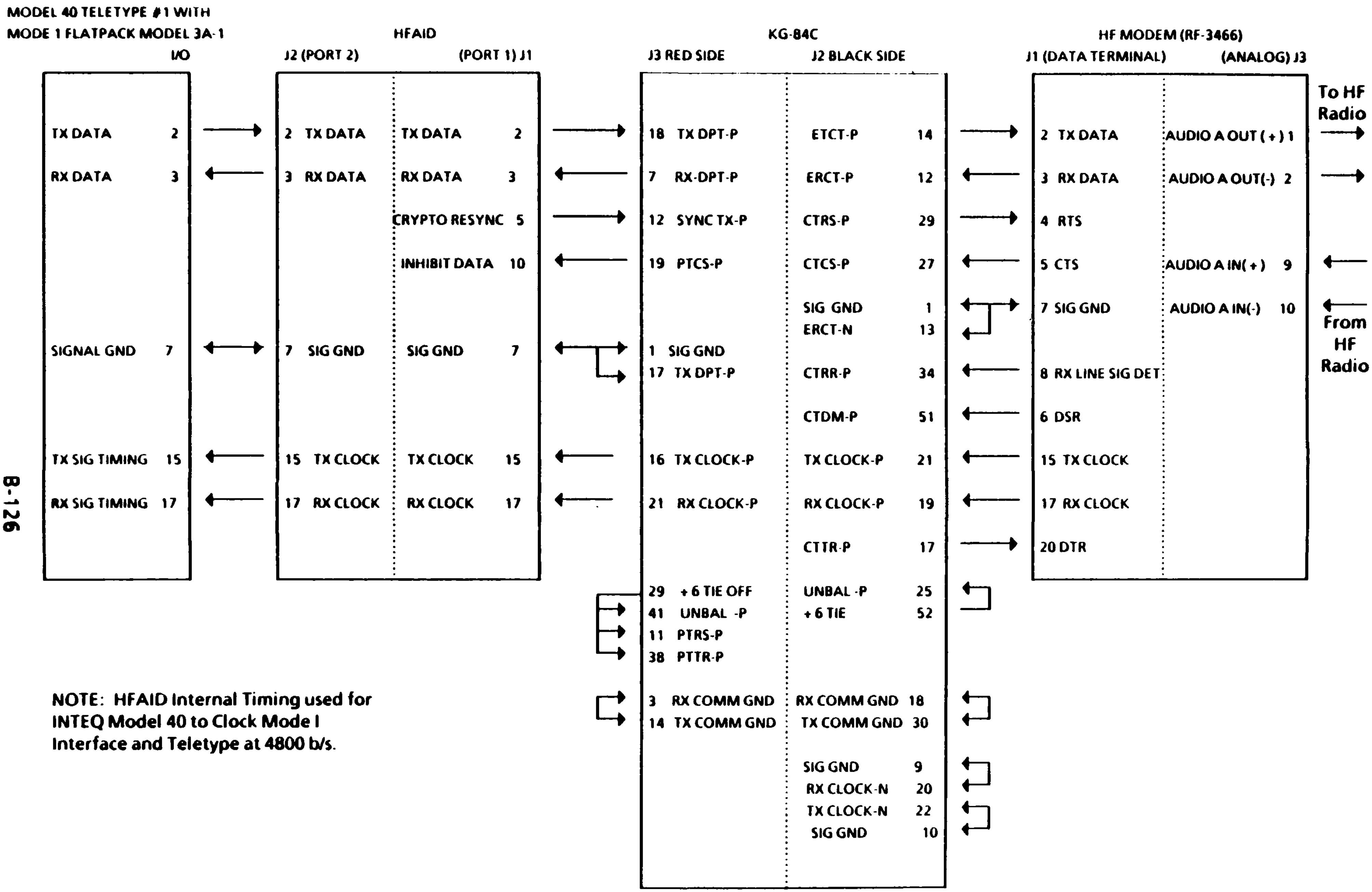


Figure B-108. Mode 1 Teletype (Model 40), ASC, HFAID, TSEC/KG-84C and HF Modem (RF-3466) Interconnect Diagram (Phase III)



Fort Huachuca

Figure B-109. Mode I Teletype Terminal (Model 40), HFAID, TSEC/KG-84C and HF Modem (RF-3466) Interconnect Diagram (Phase III)

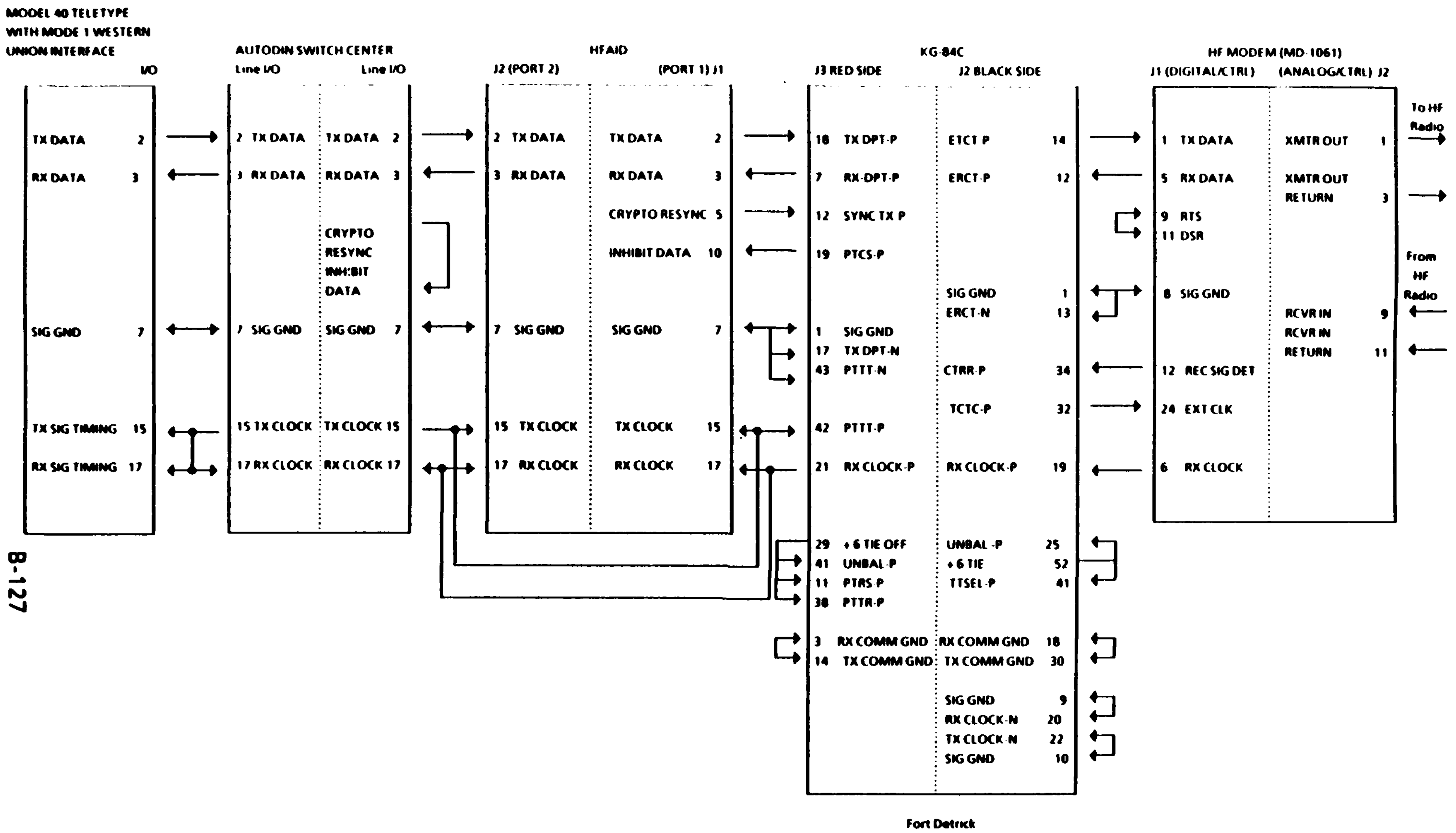


Figure B-110. Mode 1 Teletype (Model 40), ASC, HFAID, TSEC/KG-84C and HF Modem (MD-1061) Interconnect Diagram (Phase III)

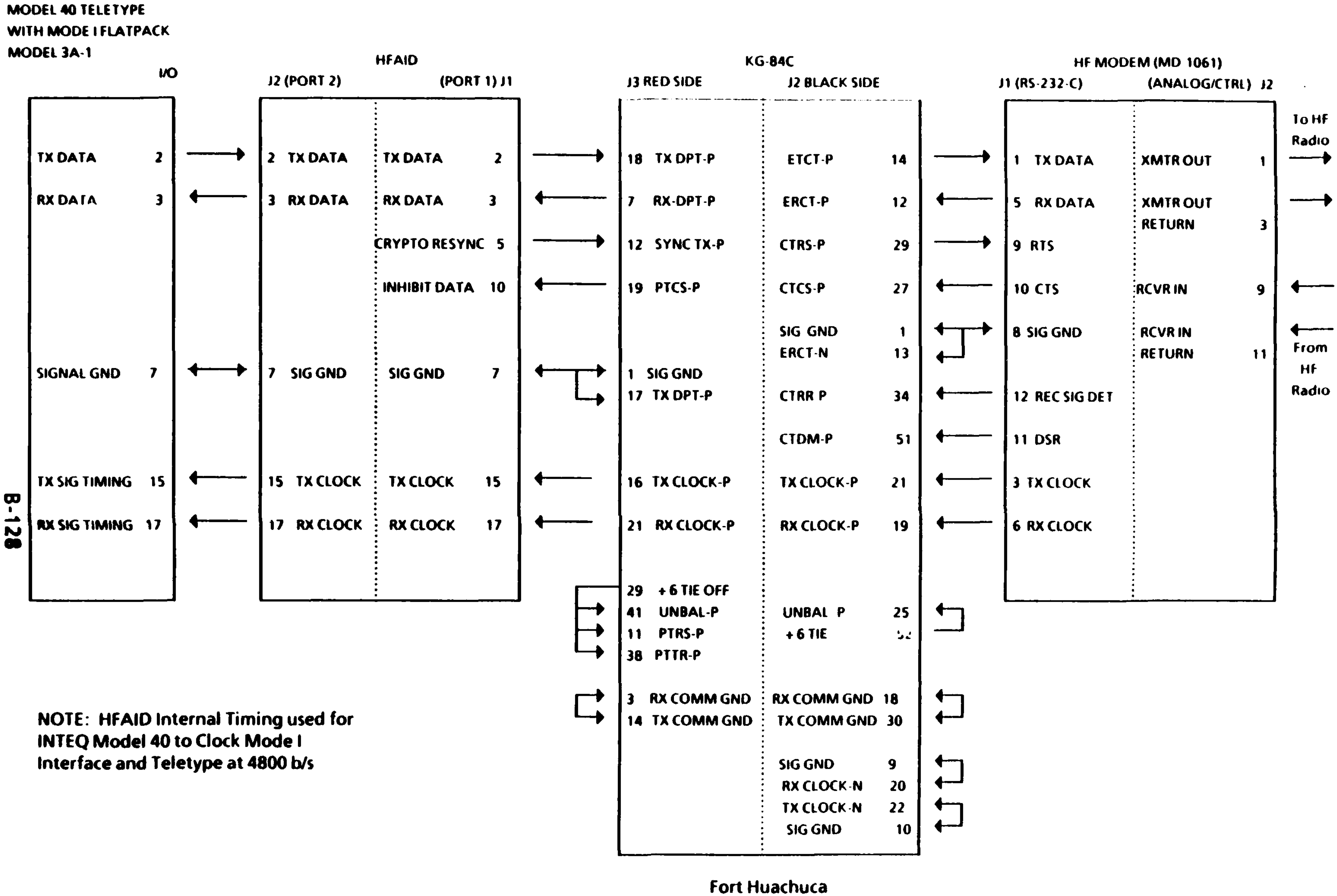
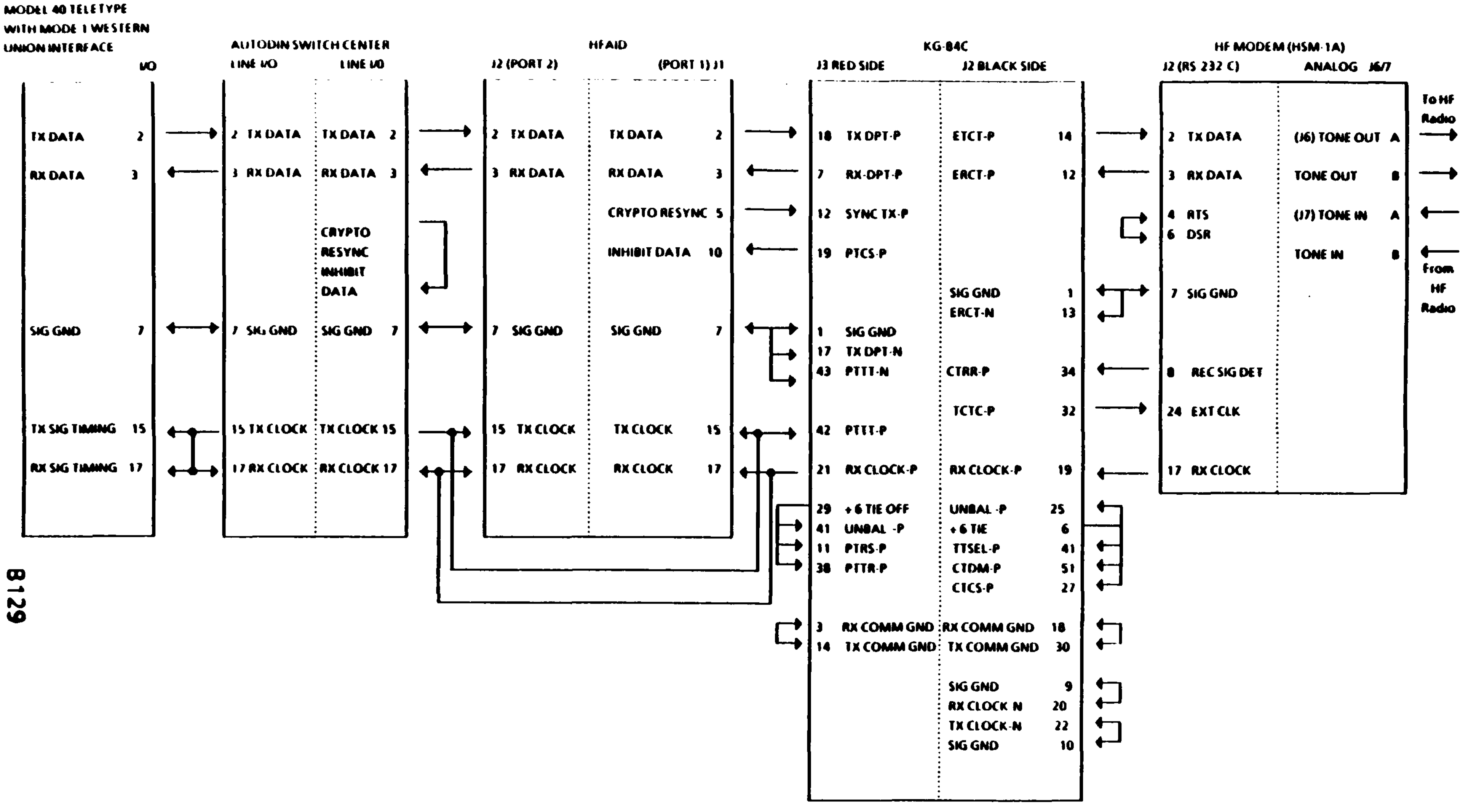
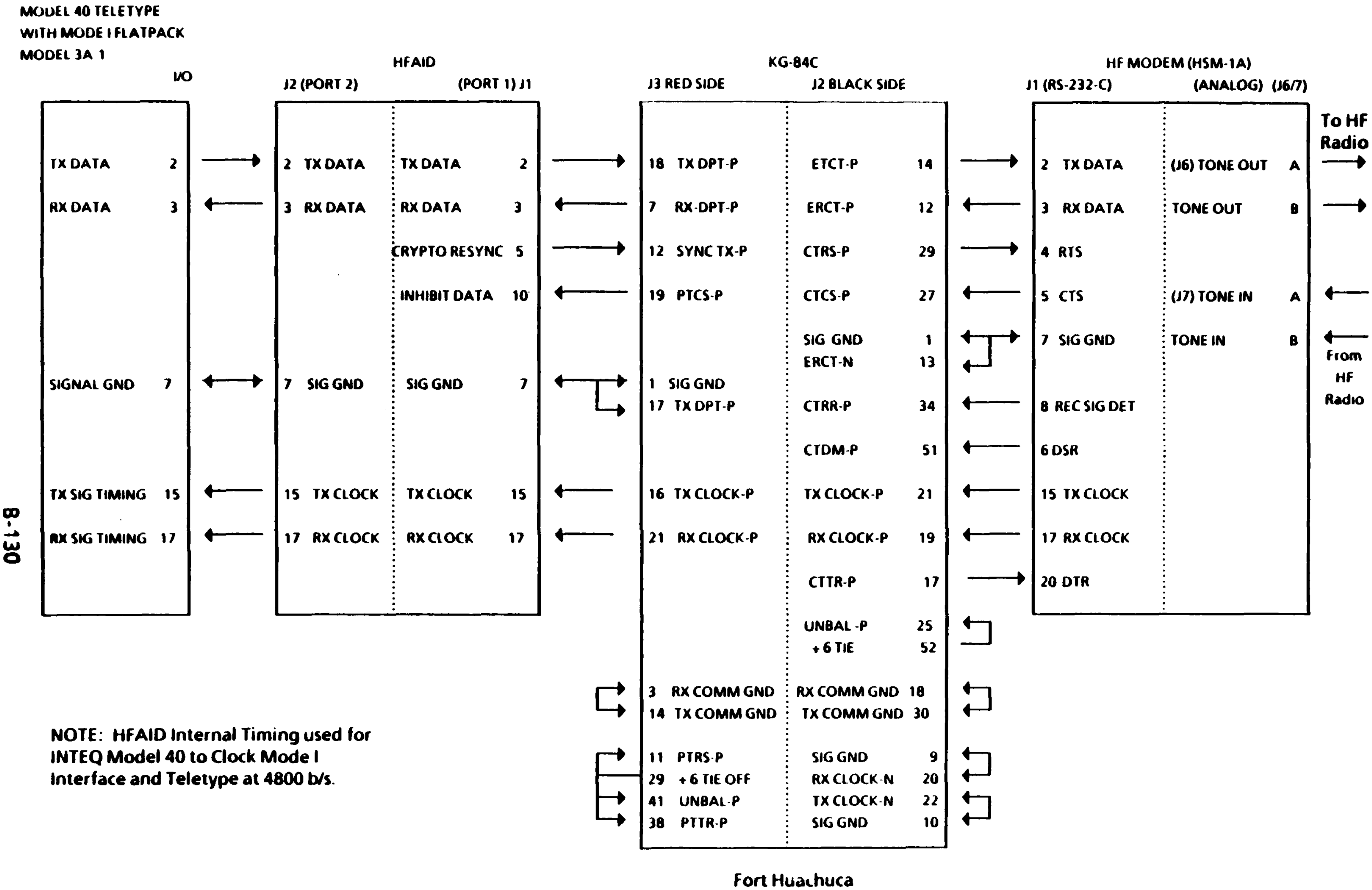


Figure B-111. Mode I Teletype Terminal (Model 40), HFAID, TSEC/KG-84C and HF Modem (MD-1061) Interconnect Diagram (Phase III)



Fort Detrick

Figure B-112. Mode 1 Teletype (Model 40), ASC, HFAID, TSEC/KG-84C and HF Modem (HSM-1A) Interconnect Diagram (Phase III)



NOTE: HFAID Internal Timing used for INTEQ Model 40 to Clock Mode I Interface and Teletype at 4800 b/s.

Figure B-113. Mode I Teletype Terminal (Model 40), HFAID, TSEC/KG-84C and HF Modem (HSM 1A) Interconnect Diagram (Phase III)

Table B-8. HSM-1A Switch Settings

(1) EXTERNAL SWITCH SETTINGS

Switch Function	Setting
Code Level	Synchronous
Baud Rate	1200 or 2400
Mode	Norm

(2) INTERNAL STRAPPING OPTIONS/SWITCH SETTINGS: None.

(3) INTERLEAVER/DEINTERLEAVER: Factory set to 3.5 sec for 1200 and 2400 b/s.

Table B-9. RF-3466 Switch Settings

(1) EXTERNAL SWITCH SETTINGS:

Switch Function	Setting
Mode Select (75-2400 b/s)	1200 and/or 2400

(2) NTERNAL STRAPPING OPTIONS/SWITCH SETTINGS:

Switch Function (Digital I/O PWB Assembly)	Setting	
S3-1, Data Mode	Sync	
S3-2, Full/Half Duplex	Full Duplex	
S6-7, 8 Channel Diversity	A	
S6-2, Doppler Tracking	Enable	
S6-3, Clipping	Enable	
S3-5, Interleaving Factor	Normal = closed; Alternate = open.	
S3-6, Interleaving Factor	Long = open Short = closed.	
	Data Rate	**MODE (End-to End)**
	1200	Normal Long (12.6 sec)
	1200	Alternate Short (1.71 sec)
	2400	Alternate Short (1.58 sec)
	2400	Normal Long (9.8 sec)
S4-2, Halt on Fault	Enable	
S4-4, Send Test Message	Disable	
S4-3, Loopback	Disable	
S3-7, 8 Keyline Delay	45 msec	
S1, RS-232-C/MIL-STD-188C	RS-232-C	
S2, Frequency Select	INT (Internal Clock) if Clock from Modem DTE (External CLock) if Clock to Modem	

Table B-10. MD-1061 Switch Settings

(1) EXTERNAL SWITCH SETTINGS:

Switch Function	Setting
Transmitter Key	Remote
Transmitter Output	Data
Transmitter Data Source	EXT
Transmitter Coding Mode	Coded
Transmtter Data Rate	1200 or 2400
Receiver Coding Mode	Coded
Receiver Data Rate	1200 or 2400
Receiver Diversity	A
Receiver Frequency Connection	On
Receiver Sync	Fast and Slow
Operate Mode	Normal

(2) INTERNAL STRAPPING OPTIONS AND SWITCH SETTINGS:

Function	Strap
Preamble Length in Frames	5 (E1 to E2) A2 Card
Degree of Interleaving (TX)	Switch ON A27 Card:
Degree of De-Interleaving (RX)	Switch ON A28 Card:

Data Rate	Delay	Switch Position Closed
1200	1.6	5
1200	6.4	7
2400	0	None

Table B-11. TSEC/KG-84C Switch Setting

(1) EXTERNAL CLOCK TO HF MODEM:

Switch Function	Setting
Clock	MA (Master)
Data Rate (TX)	INT 1200 or 2400
Data Rate (RX)	EXT
Data Length	Synchronous
TDM	OFF
Sync Mode	6 (HF)
Comm Mode	1 (Duplex)
TTY Mode Switch	1 (Auto Resync)
Sync Switch	OFF
Gated RXC	CRXC
Gated TXC	CTXC

(2) EXTERNAL CLOCK FROM HF MODEM:

Clock	MA (Master)
Data Rate (TX/RX)	EXT
Data Length	Synchronous
TDM	OFF
Sync Mode	6 (HF)
Comm Mode	1 (Duplex)
TTY Mode Switch	1 (Auto Resync)
Sync Switch	OFF
Gated RXC	CRXC
Gated TXC	CTXC

(3) INTERNAL STRAPPING OPTIONS/SWITCH SETTINGS:

Strap	Setting
PTRS (Char Pass)	Out (E2-E3) (For simplex HF mode only)
Time (Sec)	15 (E8-E4) (For simplex HF mode only)
IDLS	Out (E11-E12) (For simplex HF mode only)
KEK (VU)	Out (E13-E14) (For simplex HF mode only)
DATA MODE	Out (Baseband)

Table B-12. HFAID Switch Settings

(1) EXTERNAL SWITCH SETTINGS: None.

(2) INTERNAL STRAPPING OPTIONS/SWITCH SETTINGS:

Switch Function	Setting	Results
DIP Switch Bank 1 (Line 2)	S1 S2 S3 S4	
Baud Rate for Internal Timing	1 0 1 1	4800 baud (Ft. Huachuca)
	External (Ft. Detrick)	
(N/A when external clock is selected)		
DIP Switch Bank 2		
Number of characters per		
HF Aid Block (Packet:	S6 S7 S8	
	0 0 0	80 Character Block
	0 0 1	40 Character Block
	0 1 0	20 Character Block
	0 1 1	10 Character Block
	1 0 0	5 Character Block
	1 0 1	5 Character Block
	1 1 0	5 Character Block
	1 1 1	5 Character Block
Crypto Polarity	S1 = 1 (Negative)	
Dip Switch Bank 3		
No Reply Counter Settings:	S7 S8	
	1 1	255 Transmissions before CAN
Block Ignore Counter Settings		
Before Crypto Resync:	S1 S2	
(80 Character Block)	1 1	Ignore 384 blocks
Strapping		
Internal/External Clock Selection	Line 1 - External (Ft. Detrick)	
	Line 2 - External (Ft. Detrick)	
MARK Sense Selection	Line 1 - Positive MARK	
	Line 2 - Positive MARK	

Message Exchanged Between Model 40/Mode I (INTEQ) Terminal and the HFAID
Mode I Input

SITE: Fort Huachuca, AZ
DATA RATE: 4800 b/s (Model 40)
4800 b/s (Mode I Interface)

```
Tx                                    FULL DUPLEX
Rx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSHRATUZVW RUQQTXA0001 1234567
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYH
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   -UUUU--RUQQSDA.CCLZNR UUUUUCCLBTCCLTHIS IS A TEST OF EFSSSSSSSSSSSSSSSSS
                   RRF           RRF  RRF                B YYYYYYYYYYYYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   SSSSSSSSSSSSS7THE HFAID HF INTERFACE FROM FT HUACHUCA TO FT DETRICK.CCL5
     YYYYYYYYYYYYXF                                                      RRF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   . LARRY YOU MUST MAKE EFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7AN APPOINT TO BE
                          B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   RECAL BEFORE THE END OF JULY....CCLTHE QUICK BROWN FOX JUMPED OE>SSSSSSS
                                   RRF                             B YYYYYYY
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYY
     -----------------------------------------------------------------------
Rx   SSSSSSSSSSSSSSSSSSSSSS7VER THE LAZY DOGS BACK 1234567890 TIMES.....CCLR
     YYYYYYYYYYYYYYYYYYYYXF                                             RRF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRE(SSSSSSSSSSSSSSSSSSSSSSSSSSS7YRYRYRY
                                   B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx   SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYR
                                   RRF
Tx   SSSSSSSSSSSSS                                           SSSSSSSSSSSSSSSS
     YYYYYYYYYYYYY                                           YYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
Rx   YE:SSSSSSSSSSSSSSSSSSSSSSSSSSS7RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCLR
      B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYX                                  RRF
Tx   SSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
     YYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
     -----------------------------------------------------------------------
```

Figure B-114. Over-the-Air, Mode I Test Message

```
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    SS7YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCL10. OF ALL THE FISHES IN THE SEA THE
      YXF                                RRF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    MERMAID IS E8SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7THE DISH FOR ME ........CCLR
                B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF                        RRF
Tx    SSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRE.SSSSSSSSSSSSSSSSS
                                                            B YYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    SSSSSSSSSSSS7YRYRYRYRYRYRYRYRYRYCCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYR
      YYYYYYYYYYYYXF                     RRF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    YRYRYRYRYRYRYRYRYRYRYRYE:SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7RYRYRYRYRYRYRYCCLR
                             B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF               RRF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRE0SSSSSSSS
                                                                        B YYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYY
      -----------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSS7YRYRYRYRYCCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYR
      YYYYYYYYYYYYYYYYYYYYYYYXF          RRF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYE;SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7RYRYCCLI
                                           B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF    RRF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    5. THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK 1234567890 TIMES.C
                                                                            R
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    E1SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7CLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYR
      B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXFRF
Tx    SSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCLRYRE<SSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
                                               RRF   B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------------
Rx    S7YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYC
      XF                                                                          R
Tx    SSSSSSSSSSSSS                                                     SSSSSSSSSSSSS
      YYYYYYYYYYYYY                                                     YYYYYYYYYYYYY
```

Figure B-114. Over-the-Air, Mode I Test Message (cont)


```
Rx    CLRYRYRYRYE:SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7RYRYRYRYRYRYRYRYRYRYRYRYRY
      RF          B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
```

```
      YYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCLRYRYRYRYRYRYREOSSSSSSSSSSSSSSSSS
                                                     RRP               B YYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    SSSSSSSSSSSS7YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY
      YYYYYYYYYYYYXP
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    CCL20   RYRYRYRYRYRYRYE7SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7RYRYRYRYRYRYRYRYRY
      RRF                     B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSFFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCLRYRYRYRYRYRYRYRYRYRYREOSSSSSSSSS
                                                     RRP                   B YYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYY
      -----------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSS7YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY
      YYYYYYYYYYYYYYYYYYYYYYYXP
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    CCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYE:SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7RYRYRYRY
      RRP                              B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXP
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFPSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYR
                                                     RRP
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    EOSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY
      B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXP
Tx    SSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    CCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYE:SSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      RRP                                        B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSFPSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    S7RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYCCL25. OF ALL THE FISHES IN THE SEA
      XP                                    RRP
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    THE MERMAIE<SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7D IS THE DISH FOR ME........
                B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXP
Tx    SSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      -----------------------------------------------------------------------
Rx    CCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYE.SSSSSSSSSSSSSSSSSSS
      RRP                                              B YYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSS                                         SSSSSSSSSSSS
      YYYYYYYYYYYYY                                         YYYYYYYYYYYYY
```

Figure B-114. Over-the-Air, Mode I Test Message (cont)


```
      -----------------------------------------------------------------------
Rx    SSSSSSSSSSS7RYRYRYRYRYRYRYRYRYRYRYRYRYRYCCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYR
      YYYYYYYYYYXP                            RRP
```

```
Rx    YRYRYRYRYRYRYRYRYRYRYREOSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7YRYRYRYRYRYRYRYRYRY
                                B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    CCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRE:SSSSSSSS
      RRF                                                            B YYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSPFSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYY
      ----------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSS7RYRYRYRYRYRYRYCCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY
      YYYYYYYYYYYYYYYYYYYYYXF                        RRF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    YRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYREOSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7YRYRYRYRY
                                          B YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    CCL30. RYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY:
      RRF                                                                        ?
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    6SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS7RYRYCCLRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRYRY
       YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYXF      RRF
Tx    SSSSPFSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx     THATS ALL FOLKS.........................CEHS7CL#0001CCLLLLLLLLLNNNN7777?
                                               RBTXFRF      RRFFFFFFFFF     FFFFF
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSAASSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYKKYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    7777777777777777777777777777777777777777777777777777777ESSSSSSSSSSSSSSSSSS
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFX YYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYSSYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
      ----------------------------------------------------------------------------
Rx    SSSSSSSSSSSSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSS                                                 SSSSSSSSSSSS
      YYYYYYYYYYYYYYY                                                 YYYYYYYYYYYY
```

Figure B-114. Over-the-Air, Mode I Test Message (cont)


```
Rx    SSSSSSSSSSSSSSDDSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
      YYYYYYYYYYYYYY11YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
Tx    SSSSSSSSSSSSSSSSSSSRRSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
```

Table B-13. IONCAP Frequency Reliability Prediction Table
(Fort Huachuca Receive)

DRYBATCHR32

09-63 1002 ******* U S A C E E I A ******* JULY 1989
PROJECT EME FREQUENCY RELIABILITY TABLE SSN 171.0
DCA NO. TOS VOICE *
SYS ID 76-69156 1918.6 STAT.MILES 3087.6 KM REQD S/N =53 DB
****

TX FT. DETRICK, MD. * RX FT. HUACHUCA, AZ.
39.43N - 77.46W * 31.57N - 110.40W
263.07 TRUE, 272.26 MAGN. * 64.34 TRUE, 52.30 MAGN.
FREQ ANTENNA H L A * FREQ ANTENNA H L A
2-30 HUF12 L-P 30.5 25.0 90.0 * 2-30 TERM VEE 10.7 152.4 30.0
POWER = 1.000KW * 3MHZ MAN-MADE NOISE = -148 DBW*
****

GREENWICH TIME

	1900	2100	2300	0100	0300	0500	0700	0900	1100	1300	1500	1700		LOCAL FT Huachuca
FREQ	2	4	6	8	10	12	14	16	18	20	22	24		
26.0	.02	-	-	-	-	-	.32	.45	.43	.27	.18	.10	REL	
24.9	.39	.07	-	-	-	-	.31	.45	.46	.36	.26	.50	REL	
23.5	.62	.32	.13	-	-	-	.50	.41	.50	.35	.35	.68	REL	
21.5	.87	.68	.54	-	-	.08	.68	.83	.80	.85	.91	.93	REL	
19.0	.91	.86	.36	.23	-	.57	.84	.87	.73	.79	.90	.90	REL	
16.4	.84	.89	.90	.76	.37	.82	.90	.02	.12	-	.99	.78	REL	
14.5	.76	.81	.85	.84	.72	.77	.07	.14	.13	.12	.39	.62	REL	
12.0	.73	.74	.77	.84	.78	.67	.30	-	-	-	.11	.64	REL	
10.9	.71	.76	.77	.79	.75	.65	.15	-	-	-	.02	.66	REL	
5.3	.27	.49	.53	.54	.43	.03	-	-	-	-	-	-	REL	
3.2	-	.11	.15	.16	.05	-	-	-	-	-	-	-	REL	
	2	4	6	8	10	12	14	16	18	20	22	24		
	2200	2400	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000		LOCAL FT. Detric

DASHES SIGNIFY THAT RELIABILITIES ARE ZERO

* Signal/Noise figures are for 1Hz Bandwidth.

PROVIDE CIRCUIT UPDATE INFORMATION TO:
COMMANDER
U.S. ARMY INFORMATION SYSTEMS ENGINEERING COMMAND
ATTN: ASB-SET-P
FORT HUACHUCA, ARIZONA 85613-5300
(602) 538-7689 , AUTOVON 879-7689 , FTS 769-7689

Authorized Frequencies (MHz)

3.205	17.480
5.880	19.235
10.895	20.400
12.0015	23.485
16.385	24.940
	27.950

Table B-14. IONCAP Frequency Reliability Prediction Table (Fort Detrick Receive)

```
                                                                DRXBATCM??
19-63       1001 **           U S A C E E I A            * JULY        1993
PROJECT     EME      FREQUENCY  RELIABILITY  TABLE         SSN         171.0
ICA NO.                                                    TOS  VOICE        *
SYS ID  70-89155      1918.5 STAT.MILES   3087.6 KM        REQD S/N =50 DB
*******************************************************************************
TX    FT. HUACHUCA, AZ.                  * RX    FT. DETRICK, MD.
        31.57N - 110.40W                  *          39.43N - 77.46W
        64.54 TRUE,     52.30 MAGN.       *        263.97 TRUE,    272.26 MAGN.
FREQ ANTENNA       H      L      A        * FREQ ANTENNA         H      L      A
2-30 TERM  VEF  10.7 152.4   30.0         * 2-30 HORIZ L-P     30.5   25.0   90.0
POWER =   1.000KW                         *    3MHZ MAN-MADE NOISE = -148 DBW*
*******************************************************************************
```

GREENWICH TIME

	1900	2100	2300	0100	0300	0500	0700	0900	1100	1300	1500	1700	LOCAL FT HUACHUCA
FREQ	2	4	6	8	10	12	14	16	18	20	22	24	
28.0	.62	-	-	-	-	-	.23	.42	.46	.43	.19	.16	REL
24.9	.37	.12	-	-	-	-	.28	.42	.43	.40	.26	.51	REL
23.5	.66	.36	.12	-	-	-	.46	.37	.47	.34	.34	.67	REL
21.5	.87	.68	.52	-	-	.07	.65	.80	.73	.82	.82	.89	REL
19.0	.91	.90	.84	.21	-	.54	.64	.84	.70	.73	.90	.86	REL
16.4	.85	.91	.89	.74	.34	.86	.90	.01	.69	-	.88	.74	REL
14.5	.76	.81	.83	.82	.69	.76	.06	.12	.09	.08	.31	.56	REL
12.0	.73	.74	.71	.79	.76	.65	.27	-	-	-	.06	.56	REL
10.9	.69	.73	.70	.71	.72	.62	.13	-	-	-	-	.57	REL
5.3	.07	.14	.13	.22	.36	.03	-	-	-	-	-	-	REL
3.2	-	-	-	.02	.05	-	-	-	-	-	-	-	REL
	2	4	6	8	10	12	14	16	18	20	22	24	
	2200	2400	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	LOCAL FT. Detrick

DASHES SIGNIFY THAT RELIABILITIES ARE ZERO

* Signal/Noise figures are for 1 Hz Bandwidth

PROVIDE CIRCUIT UPDATE INFORMATION TO:
COMMANDER
U.S. ARMY INFORMATION SYSTEMS ENGINEERING COMMAND
ATTN: ASB-SET-P
FORT HUACHUCA, ARIZONA 85613-5300
(602) 538-7689 , AUTOVON 879-7689 , FTS 769-7689

APPENDIX C

HF MODEM CHARACTERISTICS

Table C-1. HF Modem Characteristics

MODEM	MANUFACTURER	BIT RATE (BPS)	DATA MODULATION	TRANSMIT WAVEFORM	FORWARD ERROR CODING	INTERLEAVING DELAY (SECONDS)	DUAL CHANNEL DIVERSITY (YES/NO)	EQUALIZATION	SYNCHRONIZATION ACQUISITION
MD-1061	MAGNAVOX	1200	DQPSK	16-TONE	RATE 1/2 (BCH)	1.6 6.4	YES	NO	PREAMBLE
		2400	DQPSK	16-TONE	NONE	0	YES	NO	PREAMBLE
RF-3466	HARRIS	1200	TDQPSK	39-TONE	7, 3, 2, (RS)	1.7 12.5	YES	NO	PREAMBLE
		2400	TDQPSK	39-TONE	14, 10, 2, (RS)	1.6 9.8	YES	NO	PREAMBLE
HSM-1A	PLAN-TRONICS	1200	QPSK	SINGLE TONE	RATE 1/2 (C)	3.5	YES	DFE	PULSE
		2400	8-PSK	SINGLE TONE	RATE 1/2 (C)	3.5	YES	DFE	PULSE

C = Convolutional Code
RS = Reed Soloman Code
BCH = Bose - Chaudhuri - Hocquenghem Code
DFE = Decision Feedback Equalization

* Note: Additional data rates, interleaver/deinterleaver, in-band diversity and dual channel diversity are accommodated by the modems. This table reflects only the major characteristics of each modem at the two data rates tested (1200 and 2400).